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Technical Support for Reduction of Methylene Chloride Contamination in Paint Stripping Rinse Waters at Letterkenny Army Depot

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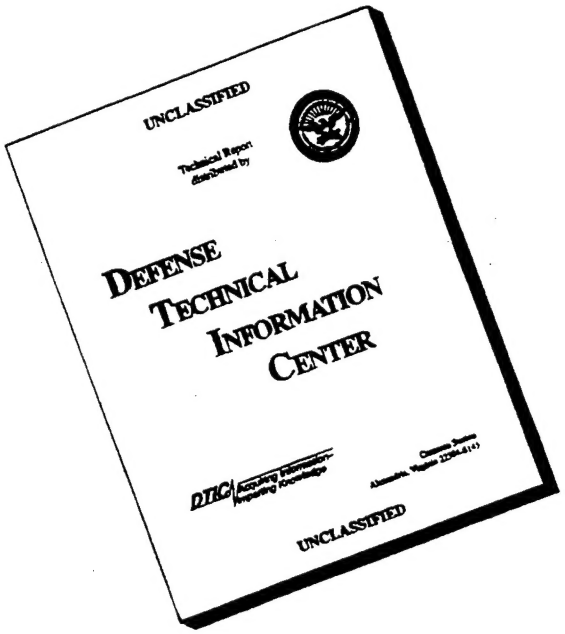

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In response to a request for technical assistance from the Letterkenny Army Depot (LEAD), the USAEC initiated an evaluation of potential options for treatment of methylene chloride contamination present in paint stripping rinse waters. Site visits were conducted and potentially applicable technologies were identified. Air sparging was recommended for further evaluation. A Test Plan was prepared for the characterization of rinse waters. A Health and Safety Plan was also completed. Prior to implementation of these plans, LEAD engineers identified and successfully implemented an alternate, non-methylene chloride based paint stripper. This process modification negated the need for evaluation of methylene chloride treatment options. This report documents the efforts conducted prior to the process change to identify and evaluate control options.

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Executive Summary

The Environmental Technology Division of the U.S. Army Environmental Center (USACE) conducts research and development to support environmental compliance at Army depots and other installations where industrial manufacturing or maintenance is conducted. In response to a request for technical support from Letterkenny Army Depot (LEAD), the USAEC initiated an evaluation of potential options for treatment of methylene chloride contamination present in rinse waters from paint stripping operations. LEAD conducts maintenance on combat vehicles, missile systems, fire control systems, and associated secondary items. As part of these operations, paint is stripped from metal parts by the use of a chemical paint stripper that contains methylene chloride. LEAD's industrial wastewater treatment plant has experienced problems in treating methylene chloride and meeting discharge limits.

The preferred solution to this problem was elimination of the use of methylene chloride. LEAD engineers pursued this goal. However, due to the problems encountered by the wastewater treatment plant, a short-term interim solution was also sought. LEAD requested assistance in evaluating the feasibility of installing a treatment system at the source to prevent or minimize the discharge of methylene chloride into the industrial sewer. The effort completed by USAEC to meet this objective is the focus of this report.

Site visits were conducted to discuss and review the methylene chloride discharge problem, to tour the paint shop, and observe the paint stripping operations. Subsequently, the following activities were completed: identification of potentially applicable technologies; preparation of a Test Plan for characterization of rinse waters; and preparation of a Health and Safety Plan. Concurrent with completion of these activities, LEAD engineers successfully implemented the use of an alternative, nonmethylene chloride-based paint stripper. This development negated the need for continued evaluation of control technologies. Therefore, subsequent phases of the planned evaluation were not completed. This report documents efforts conducted to identify and evaluate methylene chloride control technologies applicable to rinse waters at LEAD.

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1.0 Introduction

The Environmental Technology Division (ETD) of the U.S. Army Environmental Center (USAEC) conducts research and development to support environmental compliance at Army depots, ammunition plants, arsenals, and other Army installations and activities where industrial manufacturing or maintenance is conducted. In response to a request for technical support from the Letterkenny Army Depot (LEAD), the USAEC initiated an evaluation of potential options for treatment of methylene chloride contamination present in rinse waters that are associated with chemical paint stripping operations. The technical support activities provided by the USAEC through its contractor, IT Corporation, are summarized in this report.

1.1 Background

LEAD overhauls, rebuilds, and tests wheeled and tracked combat vehicles, missile systems, fire control systems, and associated secondary items. As a part of LEAD's maintenance operations conducted in Buildings 37, 350, and 370, paint is stripped from metal parts by use of a chemical paint stripper. A heated solution of methylene chloride and formic acid (Pen-Strip NPX®, a commercial product of the Penetone Corp.) has been the chemical stripper used. Metal parts are submerged in a tank containing a heated solution of NPX. The paint is loosened or dissolved and remains in the strip tank as a sludge. The stripped part is then rinsed in either a hot water dip tank or a steam rinse tank to remove stripper residues. Dragout from the strip tank contaminates the rinse water with methylene chloride. Overflow from the hot water rinse tanks and condensate from the steam tank was discharged to the on-site industrial wastewater treatment plant (IWTP). The IWTP experienced problems in treating methylene chloride and concerns existed regarding its ability to continuously meet the discharge requirements.

LEAD's IWTP is operated under a National Pollution Discharge Elimination System (NPDES) permit that includes a discharge limit of 0.052 ppm for methylene chloride. In an effort to ensure compliance with this discharge limit and to enhance employee health and safety, the production engineering staff of LEAD initiated efforts to eliminate use of methylene-chloride-based paint strippers. In the interim, LEAD requested assistance in evaluating technologies that could remove methylene chloride at the production source (i.e., the rinse tanks). The objective of the effort documented in this report was to identify a treatment technology that could

be used on a short-term basis to remove methylene chloride from the rinse water and condensate. This would help ensure NPDES compliance until an acceptable substitute stripper could be selected, procured, and put in service.

1.2 Technical Approach

Site visits were conducted to discuss and review the methylene chloride discharge problem at LEAD. Trip reports documenting these visits are included in Appendix A. The site visits included tours of the paint stripping facilities to observe the use of NPX® and the operation of the water and steam rinse tanks. The visits were documented and an approach to the technical support effort was developed based on the information acquired. The planned technical approach included the following efforts:

1. Identify and review technologies applicable for removal of methylene chloride from heated water.
2. Prepare a Test Plan for the characterization of the rinse water.
3. Prepare a Health and Safety Plan for the sampling and analysis effort.
4. Implement the Test Plan to characterize the rinse water.
5. Based on the data, identify an applicable and available technology (i.e., off-the-shelf commercial unit) to remove methylene chloride.
6. Conduct a demonstration of the selected technology at LEAD.
7. Document the technical support effort.

1.3 Project Status

During completion of this technical support effort, the first three activities specified above (Identify Applicable Technologies, Prepare Test Plan, and Prepare Health and Safety Plan) were completed. Concurrent with this work, LEAD engineers proceeded with separate efforts to identify an alternate paint stripper. Prior to implementation of the rinse water characterization, an alternate stripper was identified and successfully implemented. Therefore, the remaining technical support activities planned under this Task Order were discontinued. The objective of this document is to provide a summary of the methylene chloride problem, the approach planned for characterizing the rinse waters and evaluating source controls, and the technical activities completed.

2.0 Problem Definition

Methylene chloride (dichloromethane, methylene dichloride) -based chemical paint strippers are effective and have been commonly used at Army depots and other Department of Defense maintenance facilities for many years. Methylene-chloride-based strippers are both fast acting and effective on the paint systems used on military hardware. The stripper used at LEAD contained approximately 70 percent methylene chloride and 25 percent formic acid [the Material Safety Data Sheet (MSDS) for NPX is included in Appendix E]. Methylene chloride is toxic and a suspected human carcinogen. It has the following physical properties:[1,2]

Molecular Weight	85
Boiling Point	104°F
Liquid Density	1.33 g/cc
Solubility in Water	2 percent at 20°C (20,000 ppm)
Vapor Pressure	350 mm Hg
Henry's Law Constant	89 atm at 68°F

Chemical paint stripping and parts rinsing operations are conducted in Building Nos. 37, 350, and 370 at LEAD. At each location, parts are dipped in a tank containing heated NPX stripper solution. Once removed, the parts are rinsed with water. In Building No. 370, a hot-water (180° to 200°F) dip tank (Tank No. T-3) is used to rinse parts. It has an operating volume of about 1,000 gallons (its nominal dimensions are 9.5 feet long by 4 feet wide by 4 feet deep). The tank is not mixed or agitated other than by the placement and removal of parts. Dragout of formic acid from the strip tank was reported to result in a pH of about 3.2 in the rinse water. Data on the concentration of methylene chloride in the rinse water were not available. At the time of the initial visit (August 1994), the tank was being operated for one 8-hour shift, two to three days a week. However, it is anticipated that the tank will be operated on a 4-day-per-week schedule in the future. In Building No. 350, parts removed from the strip tank are placed in a steam rinse tank (Tank No. 4192) for approximately 30 minutes. During operation, a small stream of condensate is discharged from this tank to the IWTP.

At the time that this technical support effort was initiated, various control measures had been implemented by LEAD staff to control potential discharges of rinse water contaminated with methylene chloride:

Building No. 37 - An alternative, non-methylene-chloride-based paint stripping solution was being tested (Turco® 6776).

Building No. 350 - A steam rinse is used to clean the stripped parts. Steam and volatilized methylene chloride are discharged to atmosphere; condensate (potentially containing methylene chloride) discharges to the IWTP sewer. No control measures had been implemented.

Building No. 370 - A hot water rinse is used to clean stripped parts. Overflow of the rinse tank to the IWTP had been prohibited to avoid discharge of contaminated rinse water; approximately 125 gallons makeup water was added per week to replace that lost through evaporation.

Although the contribution of methylene chloride to the IWTP loading that was attributable to these rinse tanks had not been quantified, LEAD's Production Engineering Division determined that interim control of these potential sources was prudent until an alternate stripper was put into service. The interim control measures used in Building No. 37 (replacement of NPX) and No. 370 (restriction of discharges) represented long- and short-term measures, respectively, to reduce or eliminate methylene chloride discharges to the IWTP. However, the rinse tank in Building No. 370 still had the potential to overflow, or to be discharged to the IWTP inadvertently through operator error. LEAD engineers determined that a control measure was required for this potential source. The Production Engineering Division requested technical assistance in identifying a technology that could reduce or eliminate the methylene chloride in the rinse waters in Tank No. T-3 in Building No. 370 and Tank No. 4192 in Building No. 350.

Characterizations of the rinse water and steam condensate, other than temperature and pH of the rinse water, were not available. The pH of the rinse water was reported to be about 3.2. This acidic pH was attributed to dragout of formic acid, which is a significant component of NPX. It was therefore assumed that carryover of methylene chloride was also significant. The rinse tank waters were observed to contain a significant quantity of paint solids (data on the amount of solids and the distribution of particle sizes were not available).

Several assessments of alternative paint strippers have been conducted by the USAEC, the U.S. Army Construction Engineering Research Laboratory (USACERL), the U.S. Air Force, and others. For example, an assessment of ten alternative strippers was conducted by USACERL at the Sacramento Army Depot.[3,4] More recently, USACERL initiated efforts to reformulate alternative paint strippers which would perform at or near the level of methylene

chloride strippers, yet be environmentally acceptable.[5] USACERL's efforts included development of a systematic approach to address performance and environmental, health, and safety criteria to optimize alternative chemical paint strippers.[6] Evaluations have also been conducted at LEAD to evaluate alternative strippers.[7] This testing built upon results of initial testing that had been conducted by the U.S. Air Force.[8] In addition to formal evaluations, LEAD implemented the use of an alternative stripper (Turco 6776) in Building No. 37. The use of this product was discontinued due to problems encountered with its strong odor. A formal test program was not conducted and documentation regarding the evaluation of this stripper is not available. Most recently, the use of another commercially available alternative chemical paint stripper, Turco 6088, was implemented in Building No. 37. Selection of this product by LEAD engineers was based on their knowledge of its successful use at Red River Army Depot. This stripper was found to provide acceptable results and has been substituted for the methylene-chloride-based stripper. However, formal documentation of its effectiveness is not available.

The remainder of this report documents efforts to identify methylene chloride abatement technologies. On-site testing was not conducted, however, because the depot switched to the use of Turco 6088 prior to implementation of the test program. The efforts conducted are described to serve as a source of information for investigations of methylene chloride contamination problems.

3.0 Identification of Treatment Technologies

In order to identify potentially applicable technologies, a focused literature review was conducted to identify past applications of technologies for treatment of similar waste streams. As part of this search, computerized databases including NTIS, EPA's Treatability Data Base, ATTIC, and DIALOG were accessed. Over 30 reports or citations were identified during these searches. Abstracts were reviewed and the full documents were obtained and evaluated for those deemed applicable. The literature search revealed that several biological and physical treatment technologies have been used for treatment of methylene chloride in wastewater.[9-24]

Because the specific objective of this effort was to identify proven and readily implementable control measures, only those technologies that had been implemented in full-scale and were readily available (preferably in the form of rental or lease units) were retained for further consideration. Because limited space (a maximum of 40 sq. ft of floor space) was available in the

vicinity of the water rinse and steam rinse tanks, another prime selection criteria was the size of the equipment. Candidate technologies identified are summarized in Table 1.

Activated sludge is a biological treatment technology that has been used to treat methylene chloride.[16,17] Physical treatment systems that can be used for treatment of methylene chloride in wastewater include carbon adsorption, air stripping, air sparging, and steam stripping. Published literature is available that documents the field application of these technologies. These technologies are proven and well-established, and several vendors offer a wide variety of readily available equipment. Reverse osmosis was another potential treatment technology identified during the literature search. Methylene chloride is recalcitrant toward UV/oxidation treatment. Information reported in the literature and obtained from vendors of UV/oxidation equipment (e.g., Ultrox, Inc., Santa Anna, California) confirms that this technology is not appropriate for this application.

4.0 Selection of Technology for Demonstration

Selection criteria which were used to assess the applicability of each candidate technology were: 1) size--the system must require no more than 40 sq. ft of floor space; 2) availability--it must be readily available and implementable; 3) fouling-- it must not be susceptible to fouling by solids; 4) ease of operation--it must require minimal operator control; and 5) effectiveness--the system must be capable of achieving significant reductions in methylene chloride concentrations. Specific performance efficiencies for removal of methylene chloride were not set because neither the initial concentrations, nor the flow rates of the rinse waters were known. The objectives of the planned tests described in this report included characterization of the rinse waters (flow rates and concentrations). Subsequently, tests of the selected treatment system were to be conducted. It was intended that data collected during these efforts would be used to determine which technology would best meet LEAD's short-term needs.

Table 1
Potential Treatment Technologies
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Technology	Description	Advantages	Disadvantages
Activated sludge	An aerobic, suspended growth, mixed culture, biological treatment technology applicable to treatment of many organic constituents in wastewater streams.	- Proven technology - A destructive technology, does not transfer methylene chloride to another media.	- Requires a relatively large area relative to flow rates. - Subject to upsets caused by variations in the wastewater. - A waste sludge is generated and must be disposed. - Addition of nutrients and supplemental feedstock would be required.
Carbon adsorption	A nondestructive process in which contaminants are removed from the water stream by adhering onto the large surface area of granular activated carbon by physical and chemical surface attraction phenomenon.	- Proven technology. - Systems readily available in various sizes. - Simple implementation	- For small-scale applications, carbon is not typically regenerated and is a waste. - Effectiveness decreases with increasing temperature. - Suspended solids must be removed prior to treatment.
Air sparging	A physical removal process which transfers dissolved contaminants from a liquid to a flowing gas stream at ambient pressure and temperature. Typically accomplished by bubbling air into the bottom of a tank containing the liquid.	- Proven technology. - Can achieve high removal rates. - Effectiveness depends on vapor pressure of target compound. - Systems readily available. - Low capital and operating cost. - Simple implementation	- Not a destructive treatment, transfers methylene chloride to an air stream that could require control. - Not as effective as air stripping. - May not remove free methylene chloride that is located below the sparge ring.
Air Stripping	A physical removal process which transfers dissolved contaminants from a liquid to a flowing gas stream at ambient temperature and pressure. Typically accomplished in a packed tower with countercurrent flow of air and water.	- Proven technology. - Can achieve high removal rates. - Effectiveness depends on vapor pressure of target compound. - Systems readily available.	- Suspended solids should be removed prior to treatment; fouling of packing reduces efficiency. - Not a destructive treatment, transfers methylene chloride to an air stream that could require control.

Table 1
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Technology	Description	Advantages	Disadvantages
Steam stripping	A distillation process which separates constituents based on differences in volatility. More volatile compounds are separated from less volatile compounds by addition of heat (steam) and are discharged in a gas stream or are condensed.	- Proven technology. - Systems readily available. - Can achieve high removal rates. - Methylene chloride could potentially be recycled.	- Adversely affected by presence of solids. - Requires a steam source. - Not a destructive technology.
Reverse osmosis	A membrane separation technology in which pressure is applied to the contaminated solution to force the water through a semipermeable membrane leaving contaminant molecules behind in a concentrated solution.	- Requires relatively small space. - Recovered methylene chloride could potentially be recycled. - Systems readily available. - Proven technology. - Can achieve high removal rates.	- Low pH adversely affects membranes. - Suspended solids cause fouling and must be removed. - Testing required to select appropriate membrane. - Reject stream requires disposal.

Based on the results of the literature search and information acquisition effort, activated sludge, carbon adsorption, air sparging, air stripping, steam stripping, and reverse osmosis were identified as potential technologies that appeared applicable for treating methylene chloride in the rinse water. Application of the selection criteria to these candidate technologies is summarized in Table 2. A simple ranking system was used in the selection process; each technology was given one point for each criterion it met and zero points for those it did not. Points were summed to identify the best candidate. A discussion of these technologies and their relative advantages and disadvantages for the specific application at LEAD is presented in the following paragraphs.

Table 2

Application of Selection Criteria to Candidate Technologies

Candidate Technology	Size[a]	Availability[b]	Fouling by Solids[c]	Operator Control[d]	Capable of Reducing Methylene Chloride[e]	Total Points
Activated sludge	0	1	1	0	1	3
Carbon adsorption	1	1	0	1	1	4
Air sparging	1	1	1	1	1	5
Air stripping	1	1	0	1	1	4
Steam stripping	1	1	0	0	1	3
Reverse osmosis	1	1	0	0	1	3

[a] Floor space is limited to 40 sq. ft.

[b] The technology must be readily available or easily constructed.

[c] The technology must not be susceptible to fouling by paint solids.

[d] Operator control requirements should be minimal.

[e] The technology must be capable of significantly reducing methylene chloride concentrations in water.

4.1 Activated Sludge

Based on the review of the literature, activated sludge-based treatment systems are capable of treating methylene chloride contamination. However, biological treatment systems typically require a large area relative to the flow rate, are operator-intensive, subject to process upsets, generate a biological sludge that requires management and/or disposal, and may not be conducive to treating waste streams with variable flow rates and concentrations. For these reasons, in addition to the selection criteria summarized in Table 2, biological treatment technologies were not considered further as a potential short-term control application.

4.2 Carbon Adsorption

Carbon adsorption has been used for treatment of methylene chloride in water. Several vendors contacted regarding the applicability of this technology for the situation at LEAD confirmed that methylene chloride may be adsorbed on carbon; however, data was not available on the adsorption coefficients at elevated temperatures. (The rinse water in Building No. 370 is maintained at 180° to 200°F.)

The adsorptivity of an organic compound on activated carbon may be approximated by using the Freundlich isotherm for that compound. Freundlich isotherms are empirically derived from batch tests and are valid only for the range of temperatures at which the tests were performed. Based on the isotherm for methylene chloride (presented in Appendix B), the carbon adsorption capacity at 70°F is 1.2 mg methylene chloride per gram of carbon if the methylene chloride concentration in the rinse water is 1 mg/L. Therefore, to remove 1 mg/L of methylene chloride from 1,000 gallons of water at 70°F, approximately 7 lb of carbon would be required.

In general, adsorption capacities decrease rapidly with increasing temperatures. However, it is not valid to project isotherm data for higher temperatures (e.g., for a temperature of 180°F in the rinse tank). Laboratory tests must be conducted to obtain the isotherm data that would permit proper evaluation of this treatment technology. Alternatively, the tank water could be cooled to 70°F prior to treatment. Although this would increase the adsorption capacity of the activated carbon, the energy required to cool the water to 70°F and reheat it to 180°F would be on the order of 2 million Btu per 1,000 gallons. Furthermore, additional equipment would be required to cool the water, and a large quantity of cooling water (more than 6,000 gallons depending on the type of cooling equipment used) likely would be generated.

Advantages of carbon adsorption include the small equipment size typically necessary and the ready availability of equipment. Disadvantages include the potentially poor adsorptivity at 180°F of methylene chloride on carbon. Additionally, spent carbon requires disposal or regeneration. Disposal costs can be substantial depending on the quantity generated and the regulatory classification of the waste carbon (i.e., RCRA hazardous or nonhazardous). Additionally, the acidic pH of the rinse water may require the construction of special carbon vessels capable of withstanding corrosion from the acid.

4.3 Air Sparging

Air sparging is similar in concept to air stripping. In the situation at LEAD, air sparging could be accomplished by placement of an air distributor in the bottom of the rinse tank. Air, compressed to the differential head required, could be passed though a distribution system which would diffuse the air in small bubbles across the entire cross section of the rinse tank. Methylene chloride in the rinse water would transfer to the small air bubbles, and be discharged from the top of the tank and captured in the existing ventilation system. The rate of methylene chloride removal by air sparging is dependent on the Henry's Law Constant for methylene chloride. The removal may be approximated by the equation:

$$\frac{C_e}{C_i} = \frac{1}{1 + qH_u}$$

Where:

C_e = final concentration, mg/L
C_i = initial concentration, mg/L
q = air-to-water ratio
H_u = Dimensionless Henry's Law Constant

If it is assumed that the concentration of methylene chloride in the rinse water is 1 mg/L and that the target treated concentration is 0.052 mg/L (the NPDES discharge limit for the IWTP), it is estimated that 38 ft^3 of air per minute would be required to accomplish treatment in 8 hours. (Supporting calculations are presented in Appendix C.) A pilot-scale test would be required to confirm the assumptions used in these calculations.

The major advantages of air sparging are that implementation is simple and the capital and operating costs are low compared to other technologies. A stainless steel sparge ring (to resist corrosion) could be installed at the bottom of the tank in Building No. 370, and connected to a blower or air compressor to provide the required air supply. Alternatively, shop air, if available in sufficient quantities, could be used as the source of air.

The major disadvantages of air sparging are that the methylene chloride would be transferred from the water phase to the air phase and would be discharged to the atmosphere via the existing ventilation system. Additionally, if free-phase methylene chloride is present, it could settle to the bottom of the tank below the location of the sparge ring. Under these circumstances, this free-phase methylene chloride would not be subject to the air sparge, and consequently, not removed.

4.4 Air Stripping and Steam Stripping

Air stripping and steam stripping are similar processes in which volatile components of wastewater are removed by transferring them from the water phase to the air or steam phase. The major difference between these two processes is the stripping gas used--air in one case and steam in the other. The U.S. EPA has designated steam stripping as the Best Demonstrated Available Technology (BDAT) for treatment of methylene chloride in wastewater.[23,24] For the current application, these processes were considered together because the temperature of the rinse water (180° to 200°F) approaches the temperatures typically used for steam stripping (200° to 208°F). Therefore, air stripping and steam stripping in this application would be anticipated to behave similarly with respect to methylene chloride removal.

Commercial systems are readily available for both air and steam stripping. Systems include packed towers (with random packing) or tray-type air/steam strippers. Because tray-type strippers typically require less height (approximately 7 feet versus 18 to 22 feet for typical packed towers), they are more suitable for indoor use. For the purposes of this evaluation, it is assumed that the air or steam used for the stripping could be discharged directly into the existing ventilation ducts.

The effectiveness of air or steam stripping is determined by the Henry's Law Constant for the organic compound. This constant is the ratio, at equilibrium, of the partial pressure of the compound in the air above the air/water interface to the concentration of that compound in the water. Thus, the higher the Henry's Law Constant, the easier it is to transfer that compound from the liquid phase to the air phase (i.e., the easier it is to strip the compound). Henry's Law Constants are extremely temperature dependent, and a 10°F rise in temperature could result in a nearly three-fold increase in the Henry's Law Constant for a compound. Methylene chloride, with a Henry's Law Constant of 89 atm at 68°F, is considered to be at the low end for compounds considered feasible for air stripping. However, at the water temperatures of 180° to 200°F, stripping should be feasible. The presence of formic acid may also enhance the solubility of methylene chloride. Bench or pilot-scale test is necessary to evaluate the feasibility of air/steam stripping for this application.

A major advantage of air/steam stripping is that, unlike carbon adsorption, a waste stream (i.e., spent carbon) requiring treatment or disposal is not generated. However, air emissions are generated. It may not be possible, or permissible, to discharge the off-gas into the ventilation system, and separate ductwork or permits may be required. If steam stripping were

used, it may be necessary to condense the steam prior to discharge of the noncondensible vapors into the ductwork to prevent condensation and corrosion in the duct work. Under these circumstances, substantial cooling water may be necessary. If air stripping is employed, the rinse water would likely be cooled significantly and it would be necessary to reheat the rinse water to operating temperature. Finally, the acidic nature of the rinse water may necessitate special materials of construction capable of withstanding corrosion from the acid.

4.5 Reverse Osmosis

Reverse osmosis (RO) has been used to remove methylene chloride from wastewater. However, low pH adversely affects the performance and life of typical membranes used in RO systems. Additionally, the hollow fiber membranes used in RO units are susceptible to fouling from even small quantities of solids. The rinse waters were observed to contain carryover paint solids, both floating and suspended. However, data were not available on either the quantity or size distribution of these solids. A filtration step to remove solids larger than 0.1 mm prior to treatment would have to be included to avoid fouling of the membrane.

4.6 Technology Selection Summary

Based on the available data and the selection criteria identified, it was recommended that air sparging be considered by LEAD as a short-term control on Tank No. T-3 in Building No. 370. Field testing would be required to confirm the ability of an air sparging system to reduce methylene chloride concentrations under actual field conditions. Testing would also be required to determine the degree of reduction that could be achieved and to identify and resolve any operational concerns.

5.0 Plans for Data Acquisition

Because the concentration of methylene chloride in the rinse water and steam rinse condensate is not known and is expected to vary with operations, characterization data is essential for an accurate definition of the problem and an assessment of candidate treatment technologies. To fulfill this data need, a sampling and analysis plan was developed (Appendix D). The planned characterization effort addressed sampling of the rinse tank at various times (e.g., during both idle periods and during active operations). Additionally, the sampling planned included an assessment of concentration variations or gradients within Tank T-3. A Health and Safety Plan was also prepared to ensure the safety of employees responsible for the characterization of the rinse waters (Appendix E).

It is anticipated that the concentration of methylene chloride present in the hot water rinse tank (Tank T-3 in Building 370) and the steam rinse tank (Tank T-4192 in Building 350) are variable. This assumption is based on the fact that production levels vary significantly and that the amount of methylene chloride that is carried out of the strip tank into the rinse water is directly related to the number and types of parts processed. Current paint stripping operations involve periods of relatively intense production activity interspersed with periods of lower production or idle time. The production level in the stripping shops is dependent upon the work load received by the depot and is beyond the control of the shop operators. It is necessary to document the range of methylene chloride concentrations that occur during normal operations so that the performance requirements of a treatment system can be defined. Characterization is also required to confirm that these operations are significant sources of methylene chloride contamination and to define the level of treatment required.

The objective of the conceptual sampling plan presented in Appendix D is to characterize methylene chloride concentrations in Tank T-3 after an idle period and during and after a period of active operation. Samples taken at the top, middle, and near bottom depths of the tank under quiescent conditions were included to determine vertical stratification of methylene chloride concentrations. Because methylene chloride is significantly heavier than water (it has a specific gravity of 1.33), some stratification is anticipated. Further, if free product is present, it will sink to the lowest level of the tank. Samples taken after the tank is stirred to homogenize its contents will be used to assess average concentrations in the tank. The condensate from the steam rinse tank in Building 350 will be sampled over time during a period of operation to gain information on the variability of this steam. Because the steam rinse tank is only operated when parts are being rinsed, there is no flow during idle periods. The concentration of methylene chloride, the temperature and the pH will be determined on each sample.

In addition to the collection of samples, the data acquisition effort was planned to include documentation of the paint stripping/rinse operations that were conducted during the sampling effort. The number and types of parts processed, the number of shifts worked, the duration of idle periods and any additions of NPX or water to the tank were to be recorded.

6.0 Status and Summary

Implementation of the rinse water characterization plans described in this report was discontinued due to the successful implementation of an alternative paint stripper by LEAD. LEAD has replaced the NPX stripper with a non-methylene-chloride-based stripper (Turco® 6088A).

Although this new paint stripper is not as fast acting as the methylene chloride formulation, it has been well received by the shop operators and provides satisfactory removal of Chemical Agent Resistant Coatings (CARC) and other paint systems. This negated the need for the continued evaluation of treatment technologies for methylene chloride in rinse water and steam rinse condensate. In the event that the alternate stripper fails, the planned activities documented in this report could be resumed.

Methylene chloride-based paint strippers have been used by the Army and other DoD maintenance activities because of their ability to quickly and effectively remove various paint coatings. However, because of its toxicity and regulated status, efforts have been conducted by the Army and others to identify alternative paint strippers. The search has included assessment and development of alternative chemical formulations and evaluation of physical removal systems (e.g., plastic media blasting, water jet, thermal strippers, etc.). However, a universal replacement has not been found and methylene chloride remains the stripper of choice for some operations.

The solution to methylene chloride contamination of rinse waters requires an assessment of operational controls, such as methods to minimize dragout. Operational controls should be considered and implemented first. Once dragout has been minimized, the level of contamination of methylene chloride in the rinse water can be assessed. The variability in work loads experienced at Army depots must be taken into account during any characterization effort. Additionally, the solubility and density of methylene chloride must be considered in development of plans to characterize rinse waters. Finally, because methylene chloride is a common solvent and common contaminant in analytical laboratories, the use of appropriate quality assurance and quality control procedures (use of field or trip blanks, lab blanks, etc.) are essential, especially when dealing with low levels of contamination.

7.0 References

1. NIOSH Pocket Guide to Chemical Hazards. 1990. DHHS (NIOSH) Publication No. 117. National Institute for Occupational Safety and Health. Cincinnati, Ohio.

2. Nyer, E. K., 1993. Practical Techniques for Groundwater and Soil Remediation. Lewis Publishers. Boca Raton, Fl.

3. USACERL, 1988. Alternative Chemical Paint Strippers for Army Installations, Vol. I: Identification and Laboratory Analysis. Report No. AMXTH-TE-R-88017.

4. Renard, D. July, 1988. "The Investigation of Alternative Paint Strippers to Reduce Total Toxic Organics (TTOs) in Metal Finishing Wastewater." Proceedings of the Workshop on Environmental Considerations in the Life-Cycle of Paints and Coatings. USACERL Conference Proceedings N-88/08. U.S. Army Construction Engineering Research Laboratory. Champaign, Ill.

5. U.S. Army Research Development and Engineering Center, 1995. Army Pollution Prevention Environmental Technology Program.

6. Reinbold, K., June 1994. "Optimized Alternative Chemical Paint Strippers for Stripping Performance and Environmental and Health and Safety." Proceedings of the 18th Annual Army Environmental Technology Symposium. U.S. Army Environmental Center Williamsburg, VA.

7. Puglionesi, P., May 1995. "Alternative Paint Stripper Trials for Difficult Paint Systems." Proceedings of Department of Defense Environmental Technology Workshop "Environmental Quality Technology Advancing the Pillars Toward the 21st Century." U.S. Army Environmental Center. Hershey, PA.

8. E. G. and G. Idaho, Inc., 1994. Alternative Solvents/Technologies for Paint Stripping: Phase I. Report No. EGG-WTD-10299; AFCESA/ESL-TR-89-62.

9. American Water Works Association, 1990. Water Quality and Treatment: A Handbook of Community Water Supplies. F. Pontius, ed., 14th Edition. McGraw-Hill, Inc.

10. Dobbs, R. A. and J. M. Cohen, 1980. "Carbon Adsorption Isotherms for Toxic Organics," EPA-600/8-80-023. U.S. Environmental Protection Agency.

11. Glaze, W. H., 1980. "Oxidation of Water Supply Refractory Species by Ozone with Ultraviolet Radiation." EPA-600/2-80-110. U.S. Environmental Protection Agency.

12. Going, J. E., 1980. "Priority Pollutant Removal from Mine Drainage." EPA-600/780-121. U.S. Environmental Protection Agency.

13. Gossett, J. M., 1985. Mass Transfer Coefficients and Henry's Constants for Packed-Tower Air Stripping of Volatile Organics: Measurement and Correlation. Report No. ESL-TR-85-18. NOAA.

14. Halogenated Solvent Cleaners/Emission Control Technology and Cost Analyses, Noyes Data.

15. Keinath, T. M., 1984. "Technology Evaluation for Priority Pollutant Removal from Dyestuff Manufacture Wastewaters." EPA-600/2-84-055. U.S. Environmental Protection Agency.

16. Long, J. L., 1993. "Anaerobic and Aerobic Treatment of Chlorinated Aliphatic Compounds." EPA/600/J-93/438. U.S. Environmental Protection Agency.

17. Love, O. T., August 1982. "Treatment of Drinking Water Containing Trichloroethylene and Related Industrial Solvents." EPA/600/J-82/201. Journal of the American Water Works Association. V 74, No. 8.

18. Miller, R., 1982. "Feasibility Study of Granular Activated Carbon Adsorption and On-site Regeneration." EPA-600/2-82-087A. U.S. Environmental Protection Agency.

19. Sundstrom, D. W, 1986. Destruction of Hazardous Compounds by Ultraviolet Catalyzed Oxidation with Hydrogen Peroxide. U.S. Geological Survey.

20. Love, O.T., May 1983. "Treatment of Volatile Organic Compounds in Drinking Water." EPA-600/8-83-019. U.S. Environmental Protection Agency.

21. U.S. EPA, Office of Solid Waste, October 1989. "Proposed Best Demonstrated Available Technology (BDAT) Background Document for Wastewaters Containing BDAT List Constituents." EPA-530/SW-90/012F. Vol. 6. U.S. Environmental Protection Agency.

22. Narayanian, B., 1993. "Treatment of VOCs in High Strength Wastes Using an Anaerobic Expanded-Bed GAC Reactor, Water Research." EPA/600/J-93/437. Vol. 2, No.1, pp. 181-194.

23. U.S. EPA, Office of Solid Waste, 1988. "Amendment to the Best Demonstrated Available Technology (BDAT) Background Document for F001-F005 Spent Solvents." Vol. 1 and 2. EPA/530/SW-88/031R. U.S. Environmental Protection Agency.

24. U.S. EPA, Office of Solid Waste, 1990. "Final Best Demonstrated Available Technology (BDAT) Background Document Addendum for F002 and F005." Vol. 16. EPA/530-SW-90-059p. U.S. Environmental Protection Agency.

APPENDIX A

TRIP REPORTS: SITE VISITS TO LETTERKENNY ARMY DEPOT

INTERNATIONAL TECHNOLOGY CORPORATION

August 15, 1994

Contract No. DACA31-91-D-0074
Task Order No. 6
IT JTN 322244

Commander
U.S. Army Environmental Center
ATTN: SFIM-AEC-TSD/Mr. James Heffinger
Aberdeen Proving Ground, Maryland 21010-5401

Technical Support for LEAD

Dear Mr. Heffinger:

A project kick-off meeting was held on Friday, August 12, 1994 at Letterkenny Army Depot. The purpose of this meeting was to discuss the technical support that the depot has requested related to methylene chloride in paint stripper rinse water. Mr. Rajib Sinha and I met with Mr. Todd Johnson beginning at 0730 on Friday. We toured the paint stripping operations in Buildings No. 370 and No. 350 and discussed technical and operational issues with Mr. Johnson and Mr. Ron Pryor (Supervisor of stripping operations in Building No. 370) and with the operator in building No. 350. The attached trip notes supplement the previously submitted draft scope of work for this effort.

Please call me if you have any questions.

Sincerely,

IT CORPORATION

Robert L. Hoye
Program Manager

cc: T. Johnson
E. Engbert

Regional Office
11499 Chester Road • Cincinnati, Ohio 45246-4012 • 513-782-4700 • FAX: 513-782-4807

Minutes of Site Visit and Project Meeting
for
Hazardous Waste Minimization Technology Transfer/Implementation
Support for Depot System Command Installations

Contract No. DACA31-91-D-0074
Task Order No. 6
IT JTN 322244

August 12, 1994

Letterkenny Army Depot
Letterkenny , PA

Prepared by:
IT Corporation
Cincinnati, OH

A site visit and project meeting for the referenced Task Order was held on August 12 at the Letterkenny Army Depot (LEAD), Chambersburg, PA. The purpose of the visit and meeting was to discuss project status and acquire necessary site specific information. The following personnel participated in the meeting:

Letterkenny Army Depot

Todd Johnson - Chemical Engineer	717/267-9506
Ron Pryor - Supervisor, Building No. 370	

IT Corporation

Bob Hoye - Project Manager	513/782-4700
Rajib Sinha - Project Engineer	513/782-4700

A summary of the major issues discussed is presented below:

Overview

NPDES discharge limit for methylene chloride is 0.052 ppm. Currently LEAD is repairing industrial sewer lines and placing flow monitors on each building.

Building No. 370

Current level of operation is relatively low (one to two days/week), however, Mr. Pryor anticipates that methylene chloride stripping will be conducted on a 4-day per week schedule.

Parts are hung individually in the methylene chloride strip tanks (T-1 and T-2), then in the hot water rinse tank (T-3). This tank is maintained at 180 to 200 °F during operation.

The rinse tank has a 1000 gallon volume and is 9.5 ft long by 4 ft high by 4 ft wide.

Currently there is no overflow from this rinse tank and water must be added to make up for evaporation. Losses to evaporation exceed 6 inches of tank depth per day.

Formic acid carryover lowers the pH of the rinse water to about 3.2.

Available space for a treatment system is limited to a small space between T-3 and T-2 (29 inches wide by 48 inches high) and an area behind T-3 (approximately 4 ft wide by 10 ft long). The area behind T-3 is outside of the water containment system, therefore any system placed in this area would have to provide containment.

Concentration of methylene chloride in T-3 is not known and is anticipated to vary with the level of operation. Mr. Johnson will collect samples for analysis of methylene chloride. IT will provide input as to sample collection method.

NPDES discharge limit for methylene chloride from the IWTP is 0.052 ppm. Mr. Johnson indicated that any treatment system placed on T-3 should discharge treated water that meets this limit.

Building No. 350

The stripping operation in this building differs from that in 370. The parts are hung in baskets in the NPX strip tank, and then placed in a steam rinse tank (T-4192) for approximately 0.5 hour. Condensate from the rinse tank is discharged to the industrial sewer.

Concentration of methylene chloride in the steam rinse tank condensate is not known. Mr. Johnson will observe rinse operations on August 16 and collect a sample for analysis.

There is limited space around T-4192 for a treatment system.

Action Items

IT	Prepare Trip Report Provide information for sample acquisition in T-3
LEAD	Observe operation of T-4192 and analyze discharge for methylene chloride

INTERNATIONAL TECHNOLOGY CORPORATION

May 31, 1995

USAEC Contract No. DACA31-91-D-0074
Task Order No. 6
JTN 322244

Mr. Todd Johnson
Letterkenny Army Depot
SDSLE-MME
Chambersburg, PA 17201-4150

USAEC IVD Technical Support Project

Dear Mr. Johnson:

I have enclosed a copy of the meeting minutes prepared to document our recent visit to Letterkenny Army Depot. Please call me if you have any questions or comments or if there is any other information that you would like us to include. Additionally, I have provided a bound copy of some project materials, including meeting minutes that document trips to Corpus Christi and Anniston Army Depots, that deal with aluminum ion vapor deposition. Several of the items included are drafts. This interim material is provided for your use as backgound information for both IVD technology and our ongoing project.

I will call to discuss these materials.

Sincerely,

IT CORPORATION

Robert L. Hoye
Project Manager

cc: J. Heffinger, Jr., USAEC

Regional Office
11499 Chester Road • Cincinnati, Ohio 45246-4012 • 513-782-4700 • FAX: 513-782-4807

Minutes of Site Visit and Project Meeting
for
Hazardous Waste Minimization Technology Transfer/Implementation
Support for Depot System Command Installations

Contract No. DACA31-91-D-0074
Task Order No. 6
IT JTN 322244

May 2 & 3, 1995

Tobyhanna Army Depot
Tobyhanna, PA
and
Letterkenny Army Depot
Chambersburg, PA

Prepared by:
IT Corporation
Cincinnati, OH

Site visits and project meetings for the referenced Task Order were held on May 2 and 3 at the Tobyhanna Army Depot (TOAD) and Letterkenny Army Depot, respectively. The purpose of the visits and meetings was to discuss overall project status and receive an update on the status of site specific activities related to aluminum ion vapor deposition (AIVD) at TOAD and methylene chloride contamination in rinse waters at LEAD. The following personnel participated in the meetings:

Pat Tierney - TOAD, SDSTO-ME-E	717/894-6724
Todd Johnson - LEAD, SDSLE-MME	717/267-9506
James Heffinger, Jr. - USAEC, ETD	410/612-6846
Bob Hoye - IT Project Manager	513/782-4776
Rajib Sinha - IT Project Engineer	513/782-4694

A summary of the major issues discussed is presented below:

TOAD - Mr. Tierney indicated that the construction of the new plating shop, that would house the AIVD system, has been delayed significantly. He anticipates that the new facility is at least 3 years away, procurement of the AIVD system is currently

planned for FY99. During the meeting, several areas of potential technical assistance were discussed and are summarized below.

The design for the new plating building is proceeding. USAEC/IT could review the 60 percent design package for the proposed location of an IVD system. The schedule for the availability of the design package is not known and any review would likely be conducted on a short notice, rapid response basis.

Mr. Tierney will determine if private/commercial work can be conducted on-depot with an IVD system (i.e., partnering). Mr. Heffinger indicated that this might favorably impact the economic analysis for an IVD. If the potential exists, USAEC could assist the depot in conducting a market analysis.

The process that must be followed to requalify IVD parts (e.g., for substitution of aluminum for cadmium coatings) was discussed. The process has not been defined for parts at TOAD. The USAEC task could include further interaction/technology transfer with ANAD and CCAD to document the requalification process used by other depots and/or IT could work with Mr. Tierney to define the process at TOAD.

The National Defense Center for Environmental Excellence (NDCEE) was discussed, Concurrent Technologies Corporation (CTC), operator of the NDCEE is planning to acquire and install an IVD system. Specific interaction was not identified, however, an IVD system at the NDCEE could potentially be used for testing on TOAD specific parts, operator training, etc.

Mr. Tierney will obtain and provide an updated listing of cadmium wastes generated and their generation rates.

Other potential uses of IVD were discussed including plating of plastic parts. IT will obtain additional information this potential alternate application. Additionally, the elimination of cadmium plating requirements from part specifications was discussed.

Mr. Tierney also provided comments on the Economic Analysis (EA) previously submitted by IT. He provided updated rates (e.g., labor rates) and corrected the description of cadmium plating at TOAD (i.e., cyanide not used in cadmium baths)

Action items identified during the project meeting at TOAD are summarized below:

IT - Revise EA to reflect comments received.

Review available information on requalification of parts coatings, discuss with ANAD and CCAD, prepare summary memorandum to document initial findings.

Assess use of IVD on plastic parts and on electronics.

TOAD- Determine schedule of 60 percent design review for plating facility and need for IT review.

Determine feasibility for partnering with private/commercial IVD work on-depot.

Provide updated listing and generation rates for cadmium wastes.

LEAD - The need for implementation of the Sampling and Analysis Plan to characterize paint stripping rinse waters in Buildings 350 and 370 was discussed. LEAD has recently been using an alternate (non-methylene chloride) paint stripper in Building 370. The new stripper is Turco® 6088A, a copy of the MSDS is attached. This is the same stripper that Red River Army Depot (RRAD) has been using. The new stripper is not as fast as the methylene chloride formulation but has been well received by the shop operators and gives satisfactory removal of CARC and other paint systems. Current plans are to replace methylene chloride stripper in both buildings with the Turco® product. This will negate the need for evaluation of methlyene chloride in the water and steam rinse tanks.

It was agreed that the USAEC's methylene chloride characterization effort would be suspended unless the Turco® stripper proves unsatisfactory in the near term. In order to close out this effort, IT will prepare a document that summarizes project background, scope, and resolution. The Test and Safety Plans will be included as appendices. Mr. Johnson will provide available characterization data, from the waste characterization forms prepared for the most recent disposal of rinse water (Building 370) and steam rinse residue (Building 350). This information will be. included in the project summary.

Mr. Johnson indicated that he is interested in pursuing IVD technology for LEAD. He is currently in the initial phase of assessment. It was agreed by all that IT would provide relevant project information to supplement his data base. Trip reports, vendor information, and process information previously submitted to USAEC and TOAD by IT will be forwarded to Mr. Johnson. Information needed to complete the assessment include development of an understanding of the IVD process and how much of LEAD's work load could be plated by IVD versus conventional plating. (Currently the depot ships parts off-site for cadmium plating.) Mr. Johnson expressed interest in IVD plating of metals other than aluminum. LEAD currently uses brush plating for several specific applications. Mr. Johnson will obtain and provide a list of the metals that are brush plated. He indicated that LEAD may process several parts that are similar to parts coated by IVD at ANAD.

Mr. Johnson is planning to respond to the Army Remanufacturing and Reclamation (R&R) Thrust Area Program Call for FY96-02 Projects with an IVD acquisition request. A copy of the call for projects is attached. The depot recently

acquired a super critical carbon dioxide cleaning system through a similar mechanism.

A tour of the paint stripping operations conducted in Buildings 350 and 370 was also conducted during the visit.

Action items identified during the project meeting at LEAD are summarized below:

IT - Prepare summary of methylene chloride task to close out this activity.

Provide copies of IVD background material and trip reports.

LEAD - Provide a list of metals that are currently applied by brush coating.

ATTACHMENT 1

TURCO 6088A MSDS

TECHNICAL DATA

elf atochem

ATO

BULLETIN NO. 397

TURCO PRODUCTS, INC. • 7300 BOLSA AVENUE, WESTMINSTER, CALIFORNIA 92684-3600 • 714/890-3600

TURCO® 6088A THIN

ENVIRONMENTALLY COMPATIBLE PAINT REMOVER FOR IMMERSION APPLICATIONS

DESCRIPTION:

TURCO® 6088A THIN is a light amber, thin liquid developed for removing chemical resistant paints, such as epoxies, polyurethanes and epoxy primers, from aluminum alloys, mild steels and cast irons by immersion methods.

TURCO 6088A THIN is not recommended for use on high strength steels and thermoplastic materials.

FEATURES:

TURCO 6088A THIN offers these features:

1. Used as received — No mixing or dilution required.
2. Does not contain chlorinated solvents, phenols, chromates, ammonia, amines or heavy metals.
3. Operates from room temperature 70° to 140°F.
4. Flash point of fresh solution is over 200°F, Pensky-Marten Method.
5. Solution has low vapor emission.

USE INSTRUCTIONS:

Equipment: Tanks and associated equipment can be fabricated from mild steel or stainless steel. Stainless steel is preferred. Do not use tanks fabricated from thermoplastic materials, fiberglass or tanks with plastic liners.

Application: Transfer TURCO 6088A THIN from container to tank. Immerse parts in TURCO 6088A THIN until paint is loosened. Operate tank from 70°to 140°F. Rinse with high pressure water @ 70°to 140°F. Dry parts by any convenient method.

DISPOSAL INFORMATION:

Dispose of spent solution per local, state and regional regulations. Refer to your local TURCO Territory Manager, Region Sales Office or TURCO MATERIAL SAFETY DATA SHEET for additional disposal information.

WARNING! CAUSES SKIN AND EYE IRRITATION:

TURCO® 6088A THIN contains acidic ingredients. Avoid contact with eyes, skin and clothing. Do not take internally. Use with adequate (equivalent to outdoor) ventilation.

Protective clothing, such as a chemical face shield or goggles, boots, apron and gloves, made from acid resistant materials should be worn when handling and using this material. Respirators with mechanical filters should be worn for mist conditions.

Do not use TURCO 6088A THIN near open flames, welding arcs or torches, since hazardous gases may be formed.

Store in closed containers at temperature between 30° and 120°F.

Before using this product refer to container label and TURCO MATERIAL SAFETY DATA SHEET for additional precautionary, handling and first aid information.

NOTICE:

The above information and recommendations concerning this product are based upon our laboratory tests and field use experience. However, since conditions of actual use are beyond our control, any recommendations or suggestions are made without warranty, express or implied. Manufacturer's and seller's sole obligation shall be to replace that portion of the product shown to be defective. Neither shall be liable for any loss, damage or injury, direct or consequential, arising out of the use of this product.

TURCO MATERIAL SAFETY
DATA SHEET

TURCO 6088-A THIN

CS No.: 03553

Date: 08/02/93

****

SECTION I MANUFACTURER'S NAME AND ADDRESS

Manufacturer's Name: TURCO PRODUCTS, INC.
DIVISION OF ELF ATOCHEM NORTH AMERICA

Address: 7300 BOLSA AVENUE
WESTMINSTER, CA 92684

Emergency telephone: (202) 483 7616
For information: (714) 890-3600

****

SECTION II HAZARD INFORMATION

THE FOLLOWING INGREDIENTS ARE DEFINED TO BE HAZARDOUS PER 29CFR 1910-1200:

NAME (CAS)	CERCLA RQ	RCRA NO	SARA REPORTABLE	%
BENZYL ALCOHOL (100-51-6)	NOT LISTED	NOT LISTED	NO	45
ACGIH TLV: NOT ESTABLISHED				
OSHA PEL: NOT ESTABLISHED				
PROPYLENE GLYCOL (57-55-6)	NOT LISTED	NOT LISTED	NO	<5
ACGIH TLV: NOT ESTABLISHED				
OSHA PEL: NOT ESTABLISHED				
HYDROXYACETIC ACID (79-14-1)	NOT LISTED	NOT LISTED	NO	<5
ACGIH TLV: NOT ESTABLISHED				
OSHA PEL: NOT ESTABLISHED				

THE FOLLOWING INGREDIENTS ARE NOT REQUIRED TO BE LISTED BY 29CFR 1910-1200, BUT ARE LISTED IN CONFORMANCE WITH THE 'RIGHT-TO-KNOW' LAWS OF CERTAIN STATES, INCLUDING PENNSYLVANIA AND NEW JERSEY:

WATER (7732-18-5), SODIUM XYLENE SULFONATE (1300-72-7)

CARCINOGENS: NONE (AS DEFINED IN 29CFR 1910-1200, APPENDIX A(1)

DOT INFORMATION

PROPER SHIPPING NAME: NOT REGULATED BY DOT IN NORMAL GROUND TRANSPORTATION IN CONTAINERS OF 110 GALLONS OR LESS

SECTION III PHYSICAL PROPERTIES (TYPICAL)

Boiling point: Approx. 220 deg. F. Specific gravity: 1.02
Vapor pressure: Approx. 20mmHg Volatile, % by volume: Approx.
SCAQMD composite vapor pressure: <0.1mm Hg (calculated by Raoult's Law)
SCAQMD VOC: 530 g/l.(calculated from nominal composition)
Vapor density: >1 (air=1) Evaporation rate: <1 (BuAc=1)
Solubility in water: Appreciable pH: 3.1% in water 3.0
Appearance and odor:
Thin light amber hazy liquid - mild odor

SECTION IV - FIRE AND EXPLOSION HAZARDS:

FLASH POINT AND METHOD USED: Above 212 F. (Setaflash)
EXTINGUISHING MEDIA:
Foam, carbon dioxide, dry chemical
SPECIAL FIRE FIGHTING PROCEDURE AND PRECAUTIONS:
Use self-contained respiratory protection.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
None

SECTION V - HEALTH AND EMERGENCY INFORMATION:

EFFECTS OF OVER-EXPOSURE: EYES:
Contact with eyes may cause moderate to severe irritation.
SKIN:
Contact with skin may cause moderate to severe irritation, drying, defatting.
INHALATION:
Vapors: Moderate irritation, dizziness, headache. Mists: Severe respiratory irritation, nausea.

INGESTION:
Moderate to severe irritation of gastrointestinal tract, nausea.
MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED:
No known chronic effects that differ from acute effects.

SECTION VA - FIRST AID INFORMATION:

FIRST AID: EYES:
Flush eyes with large volumes of water for at least 15 minutes. If irritation persists, obtain medical attention.
SKIN:
Speed is essential. Flush affected area with large volumes of water. Wash with soap and water. Rinse thoroughly. If irritation is evident or blistering occurs, obtain medical attention.
INHALATION:
Remove to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, apply artificial respiration. Obtain medical attention.

INGESTION:
Do not induce vomiting except on advice of competent medical personnel. If vomiting occurs spontaneously, keep head below hip level to reduce possibility of aspiration pneumonitis. If victim is conscious, dilute by giving large volumes of milk or water. Obtain immediate medical attention. Never attempt to induce vomiting or give anything by mouth to an unconscious person.
PRIMARY ROUTES OF ENTRY ARE INHALATION AND SKIN CONTACT.

SECTION VI - REACTIVITY DATA:

STABILITY: STABLE
CONDITIONS TO AVOID:
Contact with strong oxidizing materials
HAZARDOUS DECOMPOSITION PRODUCTS:
Thermal decomposition may produce carbon monoxide, dioxide and other toxic volatile organic compounds

SECTION VII - SPILL, LEAK AND DISPOSAL PROCEDURE:

SPILL OR RELEASE PROCEDURE: CONCENTRATE
Contain spillage. Stop leak at source if this can be done safely. Ventilate area. Nonessential personnel should leave the area until cleanup is completed. Pump liquid into DOT-approved drums for disposal. Absorb remaining liquid onto inert absorbent and place in DOT-approved drums for disposal. Wash area with water. Collect washings and place in DOT-approved drums for disposal. Keep concentrate and wash water from entering sewers or waterways.
USE SOLUTION:
As for concentrate, if applicable.
DISPOSAL INFORMATION: CONCENTRATE:
(1) Transfer to reclaiming center for recycling or reuse, if possible.
(2) Transfer to licensed waste treatment or disposal site for disposition under applicable local, state and regional regulations.
SPENT SOLUTION AND RINSES:
Dispose per (1) or (2) above, or spent solution and rinses can be neutralized, and floatable soil and separated solvent skimmed off. Residual organic matter may be removed by oxidation and/or carbon treatment. Clarified water may be released to sewer if local regulations permit.

SECTION VIII - SPECIAL PROTECTION INFORMATION:

RESPIRATORY PROTECTION:
If TLV is exceeded, a NIOSH-approved self-contained breathing apparatus, positive pressure hose mask or an air line mask is advised. These should have a full face piece and be operated in a positive pressure mode. For limited exposure time, in areas of good ventilation, a full face mask with an organic vapor cartridge or canister may be used. These must not be used in any areas where a danger of oxygen deficiency exists, such as partly enclosed or low lying areas, including sumps or tanks. If respirators are used, a formal training and screening program must be initiated. See 29 CFR 1910-134.

VENTILATION:
Maintain sufficient mechanical ventilation to keep concentration below TLV.
PROTECTIVE EQUIPMENT:
Protective equipment: Face shield or goggles, gloves, boots and apron made of solvent resistant material (e.g. neoprene, viton, etc.). Protective suit not normally required.
RECOMMENDED PERSONAL HYGIENE
Wash hands and face with soap and water before smoking or eating. Immediately remove all contaminated clothing. Launder separately before reuse.

****

SECTION IX - OTHER INFORMATION:

SPECIAL PRECAUTIONS - STORAGE AND HANDLING:
Store in dry protected area away from strong oxidizing agents.
MIXING:
Carefully add to water while mixing, taking care to avoid splashing. Use appropriate safety equipment to eliminate possibility of skin or eye contact. Make additions to in-use tanks slowly and cautiously.
REPAIR AND MAINTENANCE OF CONTAMINATED EQUIPMENT:
Relieve any pressure. Cover openings to avoid spurting. Clean exterior and interior by flushing with water. Collect flushings for disposal. Use protective equipment for eyes, skin and inhalation.

****

CHECKED BY: John Distaso, Research Manager
APPROVED BY: John F. Grainger, Director Tech. Serv.
DATE PREPARED: 10/15/90 DATE PRINTED: 08/02/93 FILE NO: 6088.006/0

ATTACHMENT 2

ARMY REMANUFACTURING AND RECLAMATION THRUST AREA
PROGRAM CALL FOR FY 96-02 PROJECTS

DEPARTMENT OF THE ARMY
U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
PICATINNY ARSENAL, NEW JERSEY 07806-5000

REPLY TO
ATTENTION OF

AMSTA-AR-AES (70B)

14 FEB 1995

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Army Remanufacturing and Reclamation Thrust Area Program Call for FY 96-02 Projects

1. The U.S. Army Remanufacturing and Reclamation (R&R) Thrust Area is part of the Army Manufacturing Science and Technology (MS&T) program. The thrust area manager, is located at the Armament Research, Development & Engineering Center's (ARDEC) Energetic Systems Process Division (ESPD) at Picatinny Arsenal. The primary focus of the R&R Thrust Area is on the investigation and development of advanced technologies and techniques required for weapon system life extension, field upgrade and environmentally acceptable disassembly and disposal procedures and not on facilitization.

2. The R&R Thrust Area Manager is in the process of updating the FY 96 through FY 02 Business Plan. This office wants to ensure that your proposals receive proper consideration during the development of this Business Plan. It is therefore requested that your organization submit project proposals to U.S. Army ARDEC, AMSTA-AR-AES, Picatinny Arsenal, NJ 07806-5000, no later than 30 April 1995.

3. Enclosed you will find an "Information/Call Package" that provides further definition of the R&R Thrust Area and examples of projects that have been approved under the R&R Program. This office is willing to work with your organization in the development and submittal of proposed projects for your facility.

4. Point of contact is Mr. Upendra Patel, U.S. Army ARDEC, AMSTA-AR-AES, DSN: 880-3828 or (201) 724-3828.

FOR THE COMMANDER:

Encl

CURTIS ANDERSON, JR.
Acting Chief, Energetic Systems
Process Division

REMANUFACTURING & RECLAMATION "INFORMATION/CALL PACKAGE"

1.0 OVERVIEW

The Army Manufacturing Science and Technology (MS&T) Program has been designed to achieve significant advances in developing science - based approaches to manufacturing processes and reducing the overall costs of defense weapon systems. The application of state-of-the-art technologies is vital to the achievement of the Army's requirements. With the commitment to a streamlined Army, optimum utilization of available technology, capital and labor becomes a necessity in order to reduce production and overhaul costs.

As part of the MS&T Program, the Remanufacturing and Reclamation (R&R) Thrust has become increasingly more important due to reduced defense resources and emphasis on environmentally acceptable remanufacturing and waste disposal. As acquisition budgets continue to decrease, greater emphasis will be placed upon extending system life and upgrading older systems rather than system replacement. A large portion of the sizable, but increasingly older, inventory of current equipment will become obsolete, unsupportable and excess to the reduced needs of defense. To meet expected life extensions for existing systems, the organic industrial base must have the necessary tools.

2.0 OBJECTIVE

The R&R Thrust Area will focus efforts on initiatives to develop R&R technologies involving all existing and planned Army mission equipment. The primary focus will be on the investigation and development of advanced technologies and techniques required for weapon system life extension, field upgrade and environmentally acceptable disassembly and disposal; not facilitization. Specifically:

- Remanufacturing projects will emphasize extending system life and upgrading performance through investigation and development of improved organic base manufacturing concepts. It includes improvements through rehabilitation, reverse engineering and manufacturing of alternate components. Also included are concepts on advanced repair technologies and flexible manufacturing to upgrade the capabilities of current equipment.

- Reclamation deals with orderly dismantling of military equipment using advanced disassembly technologies and reuse of materials. Projects in this area will emphasize investigation and improvements in reclamation concepts such as recycling, ruse of critical items and materials, and environmentally safe advanced disassembly techniques.

3.0 APPROACH

To assist in the development of potential R&R projects, most of the Army's depot and GOCO facilities will be requested to submit projects for evaluation and overall prioritization. These projects should investigate and develop technologies in the following general areas:

- **Design for Remanufacture:** Investigations should be conducted to determine how and specifically what changes can be made to enhance the disassembly of equipment as it relates to equipment upgrade, disassembly and reuse.

- **Reclamation of Ordnance:** Studies and investigations need to be conducted and solutions prepared for the environmentally safe and economically acceptable disassembly of equipment and its possible application to other military and commercial areas.

- **Reclaiming of Materials:** Investigations and practical technologies must be developed for reclaiming materials such as aluminum, steel, gold, silver and composites.

- **Advanced Technology for Repair Processes:** Advanced technology to enhance repair procedures in organic facilities needs to be investigated and developed.

- **Repair and Component Salvageability:** Investigations and development of improved technologies for reusing components need to be identified. An example would be for reusing printed circuit boards (i.e., optimum usage and practical conversion to new applications).

Each project should be submitted in the attached format (encl 1). The R&R Program Office is available to assist in the development, formulation and submittal of proposed projects for each of the depot and GOCO facilities. For assistance, please contact Mr. Upendra Patel, U.S. Army ARDEC, AMSTA-AR-AES, Picatinny Arsenal, NJ 07806-5000 (Tel. 201-724-3828). Each proposed project must be received no later than 31 April 1995 by the R&R Thrust Area Manager.

The following criteria will be utilized to evaluate proposed R&R projects:

- Technical Risk
- Project Cost (and Financial Risk)
- Return-on-Investment (ROI)
- Intangible Benefits
- End Item Applicability
- Technology Transfer Potential
- Schedule

The R&R program office will then select the R&R projects and fund them starting in FY96.

4.0 EXAMPLES

Attached as enclosure 2, you will find an example of a typical R&R project proposal for your information. It should be noted that your proposed R&R project submissions should follow the enclosure 1 format. It should also include a milestone schedule showing the project plan including contract or other government agency efforts and a breakout of funding expenditure by fiscal year.

Remanufacturing and Reclamation Thrust Proposed Project

1. Facility:

2. Proposed Project Title:

3. Current Problem the Proposed Project Solves:

4. What weapons platforms or subsystems will benefit from the project?

   a. Weapon Platforms:
   b. Subsystems:
   c. Tri-Service Impact (if any):

5. What is the acquisition or repair profile for these systems? Or Subsystems?

System/ Subsystem	Number of Systems/Subsystems			
	FY96	FY97	FY98	FY99

6. Provide an estimate of project development and implementation costs by fiscal year.

	Investment Funds ($K)			
	FY96	FY97	FY98	FY99
Project Development Cost				
Implementation Cost				

(Should include contract effort by year and funding)

7. Detail the benefits that are anticipated (i.e., economic, performance, defense conversion, environmental, or safety, et. al.).

8. Project Milestones:

9. Provide project risk assessment. Rate as high, medium or low. Please explain rating.

   a. Technical:
   b. Financial:
   c. Schedule:

10. Background:

   a. Current Process Employed:

   b. Proposed Solutions (to include technologies and timetable/schedule of key tasks):

RR.1 Remanufacturing of Servovalve Assembly

1. **Facility:** Red River Army Depot
SDSRR-ME-E
Texarkana, TX 75507-5000

2. **Proposed Project Title:** Remanufacturing of Servovalve Assembly

3. **Current Problem the Proposed Project Solves:** Servo control valves (which function as the "brain" utilized to control positioning devices) are employed in airborne, nautical, land based and space systems requiring critical responsive hydraulic control mechanisms.

At present, servovalve assemblies are discarded. There is no DoD or commercial facility performing remanufacturing or repair of servovalves for either the AH-64 Apache, Multiple Launch Rocket System (MLRS) or other weapon systems.

Red River Army Depot has been selected as the first Army industrial base organic maintenance facility for the remanufacture and repair of servovalve assemblies. Indications are that none of the other branches of the military have developed, or are in the process of developing, this capability.

4. **What weapons platforms or subsystems will benefit from the project?**

Weapon Platforms: Two weapon systems will be immediately impacted by the cleaning and subsequent repair of the two different servovalve assemblies; the Apache AH-64 helicopter and the MLRS.

Tri-Service Impacts (if any): A substantial tri-service impact is anticipated should this attempt with these two servovalves prove successful.

5. **What is the acquisition or repair profile for these systems? Or Subsystems?**

System/ Subsystem	Number of Systems/Subsystems				
	FY95	FY96	FY97	FY98	FY99
Servovalves	150	150	150	150	150

NOTE: This is a new type of repair program and as such, exact workloads have not been programmed.

6. **Provide an estimate of project development and implementation costs by fiscal year.**

	Investment Funds ($K)				
	FY95	FY96	FY97	FY98	FY99
Development	xxx	xxx	xxx		
Implementation					

7. Detail the benefits that are anticipated (i.e., economic, performance, defense conversion, environmental, or safety, et. al.).

Economically, the current cost to replace the servovalves for the AH-64, MLRS and other weapon systems ranges from $4K to $12K; while rebuilding, remanufacturing or repairing the same servovalves is estimated to cost approximately $2.5K per assembly. There are an estimated 250K servovalves in service worldwide. The successful execution of this project will result in the savings of up to $1.5M per year for the two Army systems (i.e., AH-64 Apache and MLRS). This will increase significantly when other Army and tri-service weapon systems are included.

The current estimate for the workload for the valves being addressed is approximately 75 per year per valve type, or an anticipated workload of approximately 150 valves per year. Once the capability is established, there should be a much greater workload if the process is expanded to address the many other servovalves in the Army's and other services' inventories.

8. Program Milestones:

9. Provide project risk assessment. Rate as high, medium, or low. Please explain rating.

a. Technical: Low. The basic technology has been demonstrated in the commercial sector.

b. Financial: Low. Per status of technology, the financial/technical risk is low.

c. Schedule: Low. No long lead time items are anticipated.

10. Background:

a. Current Process Employed: Servovalve assemblies are discarded.

b. Proposed Solution (to include technologies and timetable/schedule of key tasks):

Red River Army Depot proposes to perform remanufacturing and repair of servovalve assemblies for the AH-64 Apache and the Multiple Launch Rocket System (MLRS) by developing an environmentally acceptable process. This remanufacturing and repair process will utilize "state-of-the-art" disassembly, repair, cleaning, reassembly and recertification processes for reuse. Since servovalve assemblies have critical tolerances of up to 50 mils, detailed application studies will be performed on the Apache and MLRS servovalve assemblies. This technology will then be applied to all three services' servovalve assemblies.

APPENDIX B

FREUNDLICK ISOTHERM DATA FOR METHYLENE CHLORIDE

EPA-600/8-80-023
April 1980

CARBON ADSORPTION ISOTHERMS FOR TOXIC ORGANICS

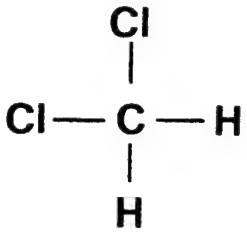
by

Richard A. Dobbs
Jesse M. Cohen
Wastewater Research Division
Municipal Environmental Research Laboratory
Cincinnati, Ohio 45268

MUNICIPAL ENVIRONMENTAL RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

COMPOUND: Methylene chloride

STRUCTURE:



FORMULA: CH_2Cl_2 **MOL. WT.** 84.94

FREUNDLICH PARAMETERS	pH		
	5.8		
K	1.30		
1/n	1.16		
Corr. Coef. r	0.96		
INITIAL CONC. mg/l	ADSORPTION CAPACITY, mg/gm		
10	19.0		
1.0	1.3		
0.1	0.09		
0.01	0.006		

CALCULATED CARBON REQUIREMENTS TO ACHIEVE INDICATED CHANGE IN CONCENTRATION (a)

SINGLE STAGE POWDERED CARBON

C_o, mg/l	C_f, mg/l		
	0.1	0.01	0.001
1.0	10,000	>100,000	>100,000
0.1		14,000	>100,000
0.01			21,000

GRANULAR CARBON COLUMN

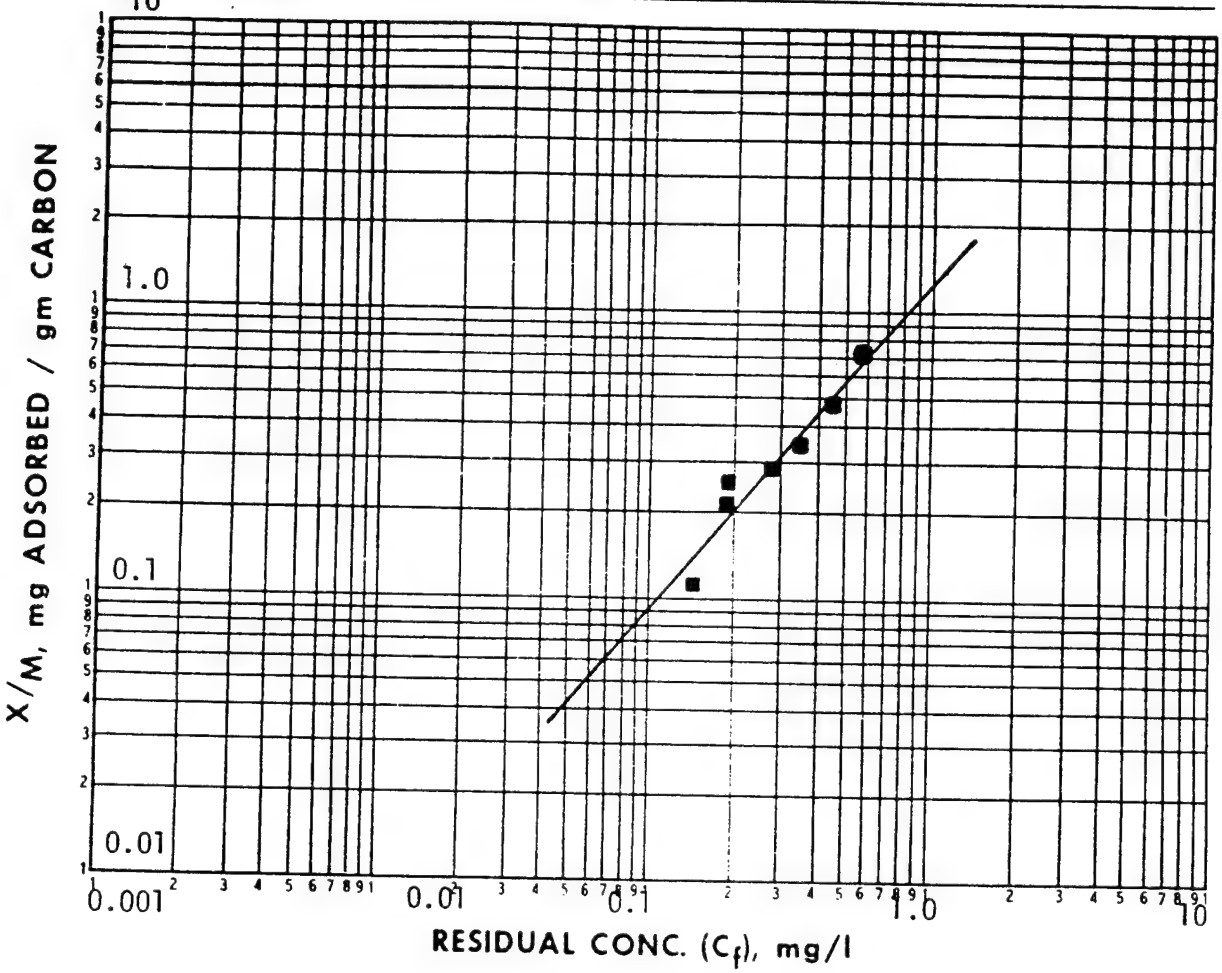
C_o, mg/l	
1.0	770
0.1	1,100
0.01	1,700

(a) Carbon doses in mg/l at neutral pH.

ANALYTICAL METHOD: G.C. - Purge and Trap

REMARKS:

COMPOUND: Methylene chloride



CARBON DOSE mg/l	■ pH= 5.8			pH=			pH=		
	C_f	$C_o-C_f=X$	X/M	C_f	$C_o-C_f=X$	X/M	C_f	$C_o-C_f=X$	X/M
0	1.0								
578	0.582	0.42	0.72						
1154	0.451	0.55	0.48						
1923	0.335	0.66	0.35						
2500	0.278	0.72	0.29						
3077	0.199	0.80	0.26						
3846	0.199	0.80	0.21						
6731	0.162	0.84	0.12						

APPENDIX C

ESTIMATES OF AIR SPARGING RATES

INTERNATIONAL TECHNOLOGY CORPORATION

By RS Date 10/31/94 Subject Air Sparging Calculation for Removal Sheet No. 1 of 2
Chkd. By DS Date 10/31/94 of Methylene Chloride in Building 350 Proj. No. 322244-07

Objective: Calculate the air flow rate and time necessary to reduce methylene chloride concentrations in the hot water rinse tank in Building 350 at LEAD

Assumptions: Initial concentration of methylene chloride is 1 mg/l
Required final concentration of methylene chloride is 0.052 mg/l
Temperature of the tank is 180°F
Henry's Law Constant for methylene chloride at 68°F is 89 atm (Nyer, 1993)
In the absence of experimental data, it is assumed that the Henry's Law constant is doubled at 180°F from the value at 68°F (assumption is based on typical increase in Henry's Law constant for other compounds)
Tank volume is 1,000 gallons

Calculations: The removal of methylene chloride in the tank may be approximated by the equation (AWMA, 1990)

$$\frac{c_e}{c_i} = \frac{1}{1 + qH_u}$$

where

c_e = final concentration, mg/l
c_i = initial concentration, mg/l
q = volumetric air to water ratio
H_u = dimensionless Henry's Law constant

therefore

$$\frac{0.052}{1} = \frac{1}{1 + qH_u}$$

H_u = 89 atm at 68°F
Conversion factor converting H in atm to dimensionless: 7.49×10^{-4} at 68°F
$H_u = 89 \times 7.49 \times 10^{-4}$
H_u = 0.067 at 68°F
H_u = 0.067 x 2 at 180°F
H_u = 0.133 at 180°F

INTERNATIONAL TECHNOLOGY CORPORATION

By RS Date 10/31/94 Subject Air Sparging Calculation for Removal Sheet No. 2 of 2
Chkd. By DS Date 10/31/94 of Methylene Chloride in Building 350 Proj. No. 322244-07

$$1 + qH_u = \frac{1}{0.052} = 19.23$$

$$q = 137$$

therefore

total air required = 137 x 1,000 gallons = 137,000 gallons
= 18,315 ft^3

Assuming 8 hours is available overnight to treat the water,

Air flow rate = 18,315 ft^3 / 8 hrs x (1 hr / 60 min)
= 38 cfm

References:

American Water Works Association. Water Quality and Treatment, 14th Edition.

APPENDIX D

SAMPLING AND ANALYSIS PLAN FOR CHARACTERIZATION OF PAINT STRIPPING RINSE WATER AT LETTERKENNY ARMY DEPOT

SAMPLING AND ANALYSIS PLAN FOR CHARACTERIZATION OF PAINT STRIPPING RINSE WATER AT LETTERKENNY ARMY DEPOT

Prepared by

IT Corporation
Cincinnati, Ohio

Contract No. DACA31-91-D-0074
Task Order No. 3
IT Project No. 322244

USAEC COTR
Mr. Edward Engbert

USAEC Project Engineer
Mr. James Heffinger

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Revised
November 1995

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1.0 INTRODUCTION

In response to a request from Letterkenny Army Depot (LEAD) for technical support, IT Corporation (IT), under contract to the U.S. Army Environmental Center (USAEC), is evaluating potential options for removal of methylene chloride from rinse water associated with paint stripping at LEAD. During the performance of this evaluation, IT determined that the analytical data necessary for selection of a treatment technology and development of a design basis does not exist. This sampling and analysis plan has been developed to guide the collection and analysis of samples for the characterization of rinse water so that a design basis may be developed.

1.1 Background

LEAD overhauls, rebuilds, and tests wheeled and tracked combat vehicles, missile systems, fire control systems and associated secondary items. As a part of it's operations, LEAD utilizes chemical paint strippers. A formulation of methylene chloride and formic acid (commercial name: Penstrip NPX) is used to strip paint from aluminum parts. Chemical paint stripping operations at LEAD are conducted in Building 350 and Building 370. To clean the stripped parts, a hot water rinse is used in Building 370 and a steam rinse is used in Building 350. This sampling and analysis plan describes the methods that will be used to characterize the rinse water at these two locations.

Section 2 describes the physical settings, dimensions, and operating procedures for each rinse tank. The specific sampling procedures are discussed in Section 3. The analytical methods that will be used for analysis of the samples are documented in Section 4. Appendix A contains instructions for sample packaging and shipping. The Health and Safety Plan prepared by IT for this effort is included in Appendix B.

1.2 Objective

The objective of this effort is the acquisition of water characterization data needed for the selection and preliminary design of a treatment technology to remove methylene chloride from rinse water. A treatment technology will be implemented as part of LEAD's overall program of eliminating methylene chloride discharges to its industrial wastewater treatment plant.

2.0 RINSE OPERATIONS AND EQUIPMENT

This section provides relevant information about the rinse water tanks that will be sampled.

2.1 Building 370

The configuration of the methylene chloride strip tank (T-2) and the hot water rinse tank (T-3) are schematically shown in Figure 1. Painted parts are hung in the Penstrip NPX strip tank for a period of time. After the Penstrip NPX solution has stripped most of the paint, the part is moved to the hot water rinse tank (T-3). This process results in some carryover of methylene chloride, formic acids, and paint solids to the rinse water. During this project, only the contents of the hot water rinse tank (T-3) will be sampled.

The T-3 rinse tank has an approximate volume of 1,000 gallons. Its overall dimensions are 9.5 feet long by 4 feet high by 4 feet wide. The tank is not mixed or agitated other than by the placement and removal of parts. A push-pull ventilation system controls fumes from the tank. Carryover of formic acid from the strip tank results in a pH of about 3.2 in tank T-3. The tank is maintained at a temperature of 180° - 200°F. It is presently operated on one 8-hour shift, two to three days a week. There is no discharge of effluent from the tank. Evaporative losses are significant and fresh water is added as necessary to maintain operating levels.

The concentration of methylene chloride in the tank is not known. Based on a review of operations, it is expected to vary with the level of production activity. To acquire information on the variation due to production changes, samples will be taken when the tank is idle as well as during and after a period of operation. This will facilitate estimation of the rate of methylene chloride build-up and changes in concentration as a function of the number of parts treated.

2.2 Building 350

The paint stripping operations in this building are similar to those in Building 370 with the exception that after the parts are stripped in the Penstrip NPX strip tank, they are placed in a steam rinse tank (T-4192) for approximately 30 minutes. At the conclusion of the steam rinse cycle, a small flow of condensate from this rinse tank is discharged to the industrial sewer via a small, accessible drain. Steam and methylene chloride is discharged via an

exterior duct. Other information regarding this system, including tank dimensions or frequency of operation, is currently not available.

3.0 SAMPLING PROCEDURES

It is anticipated that the concentration of methylene chloride present in the hot water rinse tank (T-3 in Building 370) and the steam rinse tank (T-4192 in Building 350) are variable. This is a result of the variability in production levels. Current operations involve periods of relatively intense activity interspersed with periods of lower production or idle time. The production level in the stripping shops is a result of the work load placed in the depot which is beyond the control of the shop operator. To ensure that the current assessment results in recommendation of a technology that can successfully handle variability in chemical composition, it is necessary to document the range of concentrations that occur through sampling.

The conceptual plan is to characterize methylene chloride concentrations in Tank T-3 after an idle period and during and after a period of active operation. Additionally, samples will be taken at the top, middle, and near bottom depths of a quiescent tank to determine vertical stratification (methylene chloride is heavier than water). Other samples will be taken after the tank is stirred to homogenize its contents. The condensate from the steam rinse tank in Building 350 will be sampled over time during a period of operation to gain information on the variability of this stream. For each sample taken, the temperature and pH will be recorded using a hand-held pH/temperature meter. Details of the planned sampling activity and methodology are presented in the following paragraphs.

3.1 Hot Water Rinse Tank (T-3) in Building 370

A summary of the number of samples to be taken from this tank and the time of sampling are provided in Table 1. All samples taken will be recorded on the log shown in Table 2. The sampling procedure for this tank will be as follows. This procedure was developed based on our understanding of operations. The time periods between sampling may be altered depending upon the number of parts processed.

1. Following at least an overnight idle time, the following samples will be taken from the **undisturbed** tank:
   - one sample from the center of the tank approximately six inches beneath the liquid surface.
   - one sample from the center of the tank approximately two feet below the liquid surface (i.e., about mid-depth).
   - one sample near the bottom of the tank.
   - one sample near the bottom of the tank and at the perimeter.

2. After the above four samples have been taken, stir the tank manually using a paddle. Ensure that the tank contents are thoroughly mixed but avoid splashing and aeration. Take one sample from the center of the tank approximately two feet below the liquid surface (i.e., about mid-depth) and one sample from the center of the tank near the bottom.

3. Begin routine paint stripping and rinsing operations by dipping parts in the paint strip tank (T-2) followed by rinse in T-3. Record the number and general description of parts processed in this manner. Also record the time required to process the parts.

4. Following a period of operation (dependent upon the production level, maybe as short as one hour or as long as four hours), stir the tank manually using the paddle and take two samples from the center of the tank at mid-depth.

5. Continue with the paint stripping operations as in Step 3. Following an hour of operation after the first sampling event (Step 4 above), take two samples from the center of the tank at mid-depth.

6. Continue with the paint stripping operations as in Step 3. Following a third hour of operation, take two samples from the center of the tank at mid-depth and two samples near the bottom of the tank.

7. Stop paint stripping operations (if possible) after the third hour of operation. After two hours of idle time, stir the tank manually using a paddle and take two samples from the center of the tank at mid-depth.

8. After an additional two hours of idle time, stir the tank manually using a paddle and take two samples from the center of the tank at mid-depth and two samples near the bottom of the tank.

9. Repeat this sampling procedure for another day of operation.

3.2 Steam Rinse Tank (T-4192) in Building 350

The following sampling procedure will be followed for this tank:

1. Begin routine paint stripping operations by dipping parts in the paint strip tank and subsequently placing the stripped parts in the steam rinse tank (T-4192). Record the time and number of parts processed in this manner.

2. At the conclusion of the steam rinse cycle, open the valve for discharge of the condensate to the drains. Collect two samples from this discharge.

3. Repeat this sampling procedure during another cycle of operation.

3.3 Sample Identification

All samples for the analysis of methylene chloride will be collected with zero headspace in 40-ml glass vials designated for use for Volatile Organic Analysis (VOA). A bailer will be used to collect samples from the hot water rinse tank (T-3) in Building 370. No special equipment is required for sampling in Building 350. Each sample will be assigned an unique alpha-numeric number as follows:

Building No. - Sample Time (hours since start) - Sampling Location - Sample Number - Sampling Day

Where

Building Number is 350 or 370

Sample Time is hours since the initiation of sampling (as specified in Table 1)

Sampling Location is either T for top of the tank, C for mid-depth of the tank, B for near the bottom of the tank, or D for the tank discharge in Building 350

Sample Number is either 1 or 2 for the first or second sample taken from each location
Sampling Day is either the first, second or subsequent days of sampling

For example, the second sample taken from the mid-depth of the tank in Building 370 following 2 hours of operation on the first day would be labelled:

370-2-C-2-1

The collected samples will be packaged and shipped in accordance with the instructions presented in Appendix A.

4.0 ANALYTICAL PROCEDURES AND QUALITY CONTROL

The analytical method that will be used for the analyses of samples specified in this plan will be taken from the U.S. EPA's "Test Methods for Evaluating Solid Waste" (EPA/SW-846). All analyses will be conducted by Quanterra in Knoxville, TN. Quanterra will quantitate methylene chloride in the samples using EPA/SW-846 Method 8240, "Gas Chromatography/Mass Spectrometry for Volatile Organics".

The samples will be collected in 40 ml glass VOA vials. The samples must be cooled to 4°C following collection and during shipping. No other preservatives are required. The maximum holding time for the samples is 14 days. The quality control (QC) procedures for the samples will consist of trip, field, and laboratory blanks, matrix spikes and matrix spike duplicates.

TABLE 1

Summary of Rinse Tanks Sampling Procedures

Time (Hours Since Start)	Condition of Tank	Number of Parts Processed	Number of Samples	Sampling Location
Building 370				
0	Idle and Undisturbed	None	1	Center of Tank six inches below liquid surface
0	Idle and Undisturbed	None	1	Center of Tank at mid-depth
0	Idle and Undisturbed	None	1	Center of Tank near the bottom
0	Idle and Undisturbed	None	1	Perimeter of Tank near the bottom
0	Idle and Stirred	None	1	Center of Tank at mid-depth
0	Idle and Stirred	None	1	Center of Tank near the bottom
1*	Processing Parts and Stirred	As Processed **	2	Center of Tank at mid-depth
2*	Processing Parts and Stirred	As Processed **	2	Center of Tank at mid-depth
3*	Processing Parts and Stirred	As Processed **	2	Center of Tank at mid-depth
3*	Processing Parts and Stirred	As Processed **	2	Center of Tank near the bottom
5	Idle and Stirred	None	2	Center of Tank at mid-depth
7	Idle and Stirred	None	2	Center of Tank at mid-depth
7	Idle and Stirred	None	2	Center of Tank near the bottom
Building 350				
Conclusion of rinse	Discharging Condensate	As Processed **	2	Condensate discharge line

* - The time of operation will be field determined based on production levels.
** - The number of parts to be processed will be field determined.

TABLE 2

Sampling Log

Building No._____

Date	Time	Number of Parts Processed	Temperature of Rinse Water	pH of Rinse Water	Sample Number	General Description of Parts Processed

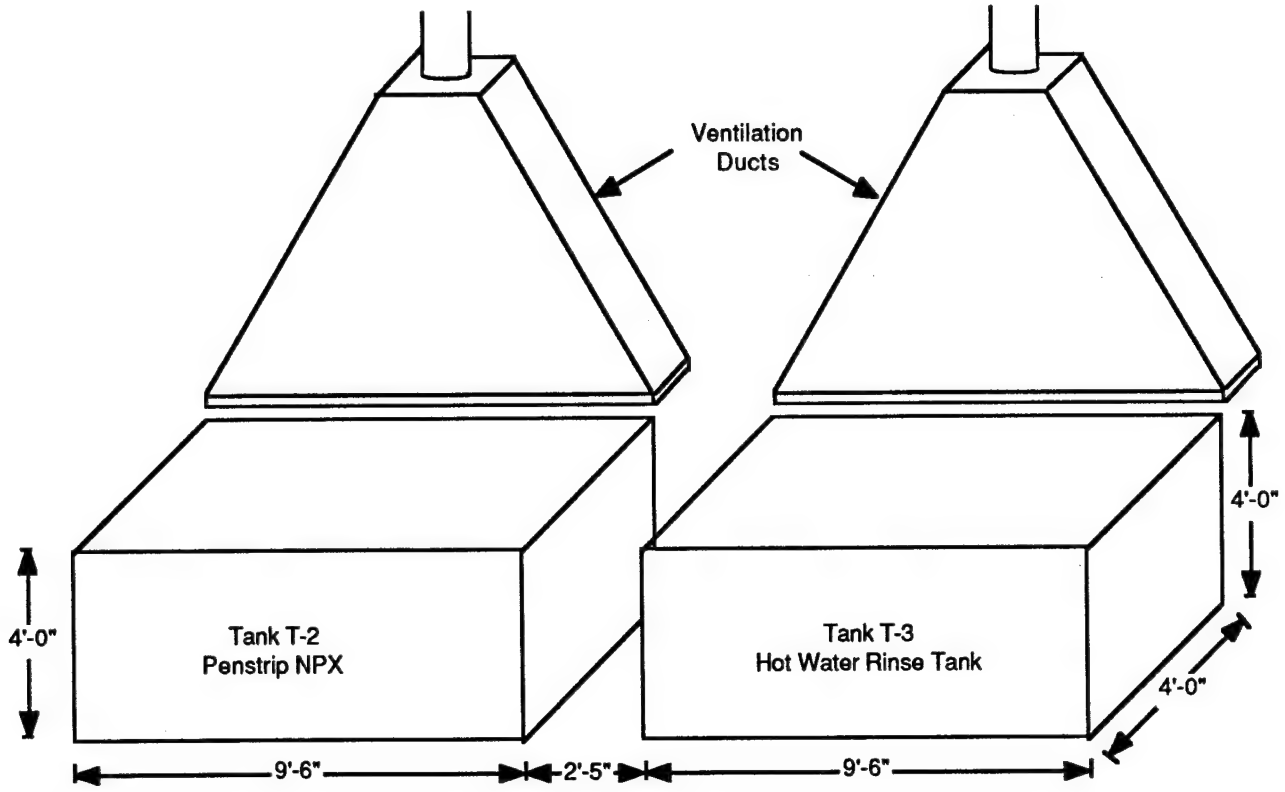


Figure 1
Schematic Configuration of Methylene Chloride Strip Tank (T-2)
and Hot Water Rinse Tank (T-3) in Building 370 at
Letterkenny Army Depot

APPENDIX A

SAMPLE SHIPPING INSTRUCTIONS

SAMPLE SHIPPING INSTRUCTIONS FOR THE RINSE TANK WATER SAMPLING AT THE LETTERKENNY army DEPOT

IT CORP
PN #322244.007.01
Revision 0
November 1994

PACKING YOUR BOX

Liquid samples of the rinse tank are placed in 40 ml vials with head space. No more than 20 of these vials may be placed into a paint can filled with vermiculite, which is then covered and placed into a 4G shipping carton packed with vermiculite. The box will be securely taped with packing tape. See directions contained within the 4G box.

The samples are required to be cooled (4°C) after sampling and to be cool (4°C) upon arrival at the lab, the paint can is placed in a cooler within the 4G box (these are available as a set from the manufacturer of hazardous shipping container). You may use blue ice or equivalent but, you may not use dry ice (this changes the hazard labeling). Prepare and ship with samples a trip blank.

Complete chain of custody.

Complete FED EX airbill as shown in example.

At arrow 1. Fed ex billing number, date, shippers name, company name, address and telephone number.

At arrow 2 Reciepents name, company name, address, and telephone number.

At arrow 3 X bill sender

At arrow 4 Determine service request

Mark an X where shown on example box marked 'Dangerous goods as per attached Shippers Declaration'

Mark an X in box #4 'Dangerous good extra charge'

Note number of packages to be shipped, weight, and declared value, and total each

Check where it says IATA/IACO

Fill in Dangerous Goods Identification as shown in example for quantity mark quantity of liquid in container times the number of containers if you are shipping 15 40 ml vials in each container. Then the entry would look like this...1 4G fiberboard box X 600 mls. **Remember the qty per fiberboard container may be no more than 1 liter.**

Mark an X in the 'Cargo Aircraft Only' box to delete this parameter

Mark an X in the 'Radioactive' box to delete this parameter

Print your name and title

Note Place and Date

Enter IT Emergency Telephone Number in Wilmington

Sign your name

LABELING YOUR BOX

Attach an address label clearly marking to and from addresses to the top of the box.
Attach dangerous goods airbill in an OPEN pouch to the top of the box.
Attach this side up labels to each short end of the box.
In black marker write on each long end of the box in the upper left hand side

Formic Acid (mixture)
UN 1779

In black marker write on each long end of the box near the bottom center (or lablels may be used)

Inner Packages Comply With Prescribed Specifications

Attach to opposite sides on each long end between the above two written statements a corrosive sticker.

Quanterra
Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
(615) 588-6401

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD*

Reference Document No. 1149
Page 1 of ___

Project Name/No. [1]
Sample Team Members [2]
Profit Center No. [3]
Project Manager [4]
Purchase Order No. [6]
Required Report Date [11]

Samples Shipment Date [7]
Lab Destination [8]
Lab Contact [9]
Project Contact/Phone [12]
Carrier/Waybill No. [13]

Bill to: [5]
Report to: [10]

ONE CONTAINER PER LINE

Sample Number [14]	Sample Description/Type [15]	Date/Time Collected [16]	Container Type [17]	Sample Volume [18]	Pre-servative [19]	Requested Testing Program [20]	Condition on Receipt [21]	Disposal Record No. [22]

Special Instructions: [23]

Possible Hazard Identification: [24]
Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐

Sample Disposal: [25]
Return to Client ☐ Disposal by Lab ☐ Archive (mos.)

Turnaround Time Required: [26]
Normal ☐ Rush ☐

QC Level: [27]
I. ☐ II. ☐ III. ☐ Project Specific (specify):

1. Relinquished by [28] (Signature/Affiliation)	Date: Time:	1. Received by [28] (Signature/Affiliation)	Date: Time:
2. Relinquished by (Signature/Affiliation)	Date: Time:	2. Received by (Signature/Affiliation)	Date: Time:
3. Relinquished by (Signature/Affiliation)	Date: Time:	3. Received by (Signature/Affiliation)	Date: Time:

Comments: [29]

White: To accompany samples
Yellow: Field copy
*See back of form for special instructions.

15/91

INSTRUCTIONS FOR COMPLETING THIS FORM

1. **Project Name/Number:** Record the name of the project or client/site location, and the billing number of the project (Example - 613215; XYZ Chemical Co. WA).
2. **Sample Team Members:** List the names of all the members of the team taking these samples; team leader's name first.
3. **Profit Center Number:** For intra company work, indicate the originating profit center number.
4. **Project Manager:** Record the project manager's name.
5. **Bill to:** Non-IT personnel should indicate the correct billing address and the person to whom the invoice should be sent. IT personnel and IT subcontractors should fill in IT office responsible for project accounting (if known).
6. **Purchase Order No.:** Non-IT personnel should use this space to record the purchase order number authorizing the analysis of these samples. IT personnel and IT subcontractors should leave this space blank if a project number has been given for billing.
7. **Samples Shipment Date:** Indicate the date these samples are shipped to the laboratory.
8. **Lab Destination:** Indicate the laboratory designated for sample shipment. Do not list more than one lab on this form. Be certain before sending samples that the laboratory you are designating is aware of the shipment and is capable of accepting these sample types and has available capacity.
9. **Lab Contact:** Give the name of the laboratory contact (typically the Lab Project Manager).
10. **Send Lab Report to:** Give the name, address and phone number of the person to receive the data report for these samples.
11. **Required Report Date :** Record the date which you and the laboratory contact have determined the results will be reported (include verbal or final report as appropriate).
12. **Project Contact/Phone:** Indicate the name of the project person to be contacted in case of any questions regarding these samples and the phone number where the contact may be reached the day the samples arrive in the laboratory.
13. **Carrier/Waybill Number:** If you are sending the samples by a commercial carrier such as Airborne or Federal Express, record the courier company name and the waybill or airbill number under which these samples will be shipped (Example - Fed-Ex/ #513631771).
14. **Sample Number:** List the complete, unique, identification number of each sample. These numbers must correspond with the identification numbers on the sample containers and the field sample collection document(s).
15. **Sample Description/Type:** Provide a short physical description of the sample and the sample type such as soil, sediment, sludge, water, wipe, air, concentrated waste or bulk.
16. **Date/Time Collected:** Record date and exact time each sample was collected. Use a 24-hour clock; i.e.,1645 not 4:45 p.m.
17. **Container Type:** Indicate the volume, color and type of the sample container used (Example - 1 gallon amber glass, 1 liter clear plastic, 40 milliliter clear glass).
18. **Sample Volume:** Estimate the amount of sample in the container. For air samples, indicate the volume of air sampled.
19. **Preservation:** Indicate what type of preservative, if any, has been used for the samples (Examples - ice to 4°C nitric acid, hydrochloric acid).
20. **Requested Testing Program:** List the analyses to be performed on each sample by method number.
21. **Condition on Receipt:** Before a custody transfer, the intended recipient should verify all samples are present and in good condition. This column may be used by the recipient to record any abnormalities found at the time of the transfer (Examples - jar lid cracked, sample bottle leaking).
22. **Disposal Record No.:** Used by the laboratory to record requisite disposal information. Not used when samples are returned to client.
23. **Special Instructions:** Use this space to record any special instructions to the lab regarding the processing of these samples.
24. **Possible Hazard Identification:** Indicate all hazard classes associated with the sample(s).
25. **Sample Disposal:** Indicate how the samples should be disposed of following analysis. All samples are held six weeks and then disposed of unless other arrangements for storage have been previously requested. Lab will charge for packing, additional archiving and disposal.
26. **Turnaround Time Required:** Check "Normal" or "Rush" as determined by the Project Manager and the laboratory contact. Rush samples are subject to a surcharge.
27. **QC Level:** These are ITAS QC levels and should not be confused with USEPA Analytical Levels.

    Level I: ITAS standard practice. Use available analytical procedures. Fifteen percent quality control (QC) samples (blank/spike/duplicate) for every 20 samples. QC samples may not be performed for a specific project but as part of compiled sets of samples. QC data not reported with analytical results. ITAS published rates apply to client samples tested.

    Level II: Use available analytical methods. Fifteen percent QC samples minimum (blank/duplicate/spike or duplicate spike) QC samples are project or client-specific. QC summary report include with analytical results. No raw data are included. Each QC sample billed as real analytical sample.

    Level III: Uses referenced regulatory procedures, and/or established/verified procedures using confirmatory techniques. Method blank plus 20 percent or tow QC summary minimum per each matrix. QC summary report supplied with supporting data. Where applicable, this is USEPA Contract Laboratory Program (CLP) package. Surcharge is added and/or QC samples are billed at sample rates. Costs based on analytical program required.

    Project-specific: Defined in QAPjP, Work Plan, or other specific plan or procedure. Project documentation must be submitted to the laboratory before beginning work. Project requirements for QC samples cannot be less than Level I.
28. **Signatures:** When releasing custody of these samples, use the "Relinquished By" space to sign your full legal name, company name, date and time of release. After verifying that all samples are present, the person receiving the samples must sign the "Received By" space to take custody of the samples.
29. **Comments:** Provide any additional explanatory information that may be required (Example - samples stored overnight in temperature controlled, secure refrigerator).

FEDERAL EXPRESS

USE THIS AIRBILL FOR DANGEROUS GOODS SHIPMENTS ONLY WITHIN THE CONTINENTAL U.S.A., ALASKA AND HAWAII
USE THE INTERNATIONAL AIR WAYBILL FOR SHIPMENTS TO PUERTO RICO AND ALL NON-U.S. LOCATIONS
QUESTIONS? CALL 800-238-5355 TOLL FREE.

PACKAGE TRACKING NUMBER 5771671824

310SM 5771671824

Sender's Federal Express Account Number: 1440-7979-5 Date: 3/8/94

1 From (Your Name) Please Print: JOHN SMITH
Your Phone Number (Very Important): (615) 690-3211
Company: I T CORP/ANALYTICAL SVCS DIV
Department/Floor No:
Street Address: 9000 EXECUTIVE PK DR STE A-110
City: KNOXVILLE State: TN ZIP Required: 37923

2 To (Recipient's Name) Please Print: I.N. KAPASITAYT
Recipient's Phone Number (Very Important): (713) 777-8210
Company: CRUMBLY CHEMICAL CO.
Department/Floor No:
Exact Street Address (We Cannot Deliver to P.O. Boxes or P.O. Zip Codes.): 3725 WHENVILLE RD
City: STENCHTOWN State: PA ZIP Required: 69521

YOUR INTERNAL BILLING REFERENCE INFORMATION (First 24 characters will appear on invoice.)

H IF HOLD FOR PICK-UP, Print FEDEX Address Here (Not available at all locations)
Street Address:
City: State: ZIP Required:

3 PAYMENT: [X] Bill Sender Acct No Req'd [ ] Bill Recipient's FedEx Acct No Fill in Account Number Below [ ] Bill 3rd Party FedEx Acct No Fill in Account Number Below [ ] Bill Credit Card Fill in Credit Card No. Below
[ ] Cash/Check Acct./Credit Card No. Exp. Date

4 SERVICES (Check only one box)
Priority Overnight 11 [ ] | Standard Overnight 51 [ ]
Economy Two-Day 30 [ ] | Government Overnight 41 [ ]
Freight Service: 70 [ ] OVERNIGHT FREIGHT ** | 80 [ ] TWO-DAY FREIGHT **
** Declared Value Limit $500

DELIVERY AND SPECIAL HANDLING (Check services required)
1 [ ] HOLD FOR PICK-UP
2 [ ] DELIVER WEEKDAY
3 [ ] DELIVER SATURDAY
4 [X] DANGEROUS GOODS
6 [ ] DRY ICE
• Dangerous Goods Shipper's Declaration not required
• Dry ice, 9, UN 1845
7 [ ] OTHER SPECIAL SERVICE
11 [ ]
12 [ ] HOLIDAY DELIVERY

Packages | Weight | Total Declared Value
Total | Total | Total

DIM SHIPMENT (Chargeable Weight) [ ] . . . . lbs

Received At: 1 [ ] Regular Stop | 3 [ ] Drop Box | 4 [ ] BSC | 2 [ ] On-Call Stop | 5 [ ] Station
FedEx Emp. No: Date/Time:

SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY
Use of this airbill constitutes your agreement to the service conditions in our current Service Guide, available upon request. See back of sender's copy of this airbill for information. Service conditions may vary for Government Overnight Service. See U.S. Government Service Guide for details.
We will not be responsible for any claim in excess of $100 per package whether the result of loss, damage, delay, non-delivery, misdelivery, or misinformation, unless you declare a higher value, pay an additional charge, and document your actual loss in a timely claim. Limitations found in the current Federal Express Service Guide apply. Your right to recover from Federal Express for any loss, including intrinsic value of the package, loss of sales, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental, consequential, or special is limited to the greater of $100 or the declared value specified in (4). Recovery cannot exceed actual documented loss. The maximum Declared Value for FedEx Letter and FedEx Pak packages is $500.00.
In the event of unknown delivery, Federal Express will at your request and with some limitations, refund all transportation charges paid. See Service Guide for further information.

SIGNATURE RELEASE UNAVAILABLE

Fedex Express Use
Base Charges
Declared Value Charge
Other 1
Other 2
Total Charges

REVISION DATE 2/91 FORMAT #069 VERSION 2.92
069
PRINTED IN U.S.A.

INSTRUCTIONS (Mark appropriate boxes)
• Dangerous Goods as per attached Shipper's Declaration [X]
• Dangerous Goods Shipper's Declaration not required [ ]
• Cargo Aircraft only [ ]

ORIGIN COPY

5771671824 AIRBILL NUMBER

SHIPPER'S CERTIFICATION FOR RESTRICTED ARTICLES/DANGEROUS GOODS
CHECK ONE ➡ [ ] 49 CFR [X] IATA/ICAO (TYPE OR PRINT)

DANGEROUS GOODS IDENTIFICATION: PROPER SHIPPING NAME	CLASS OR DIVISION	ID NUMBER	PACKING GROUP	LABEL(S) REQUIRED	PACKING INST	AUTHORIZATION
Formic Acid (mixture)	8	UN 808		1 4G FIBERB BOARD BOX X 600 MLS.	808	

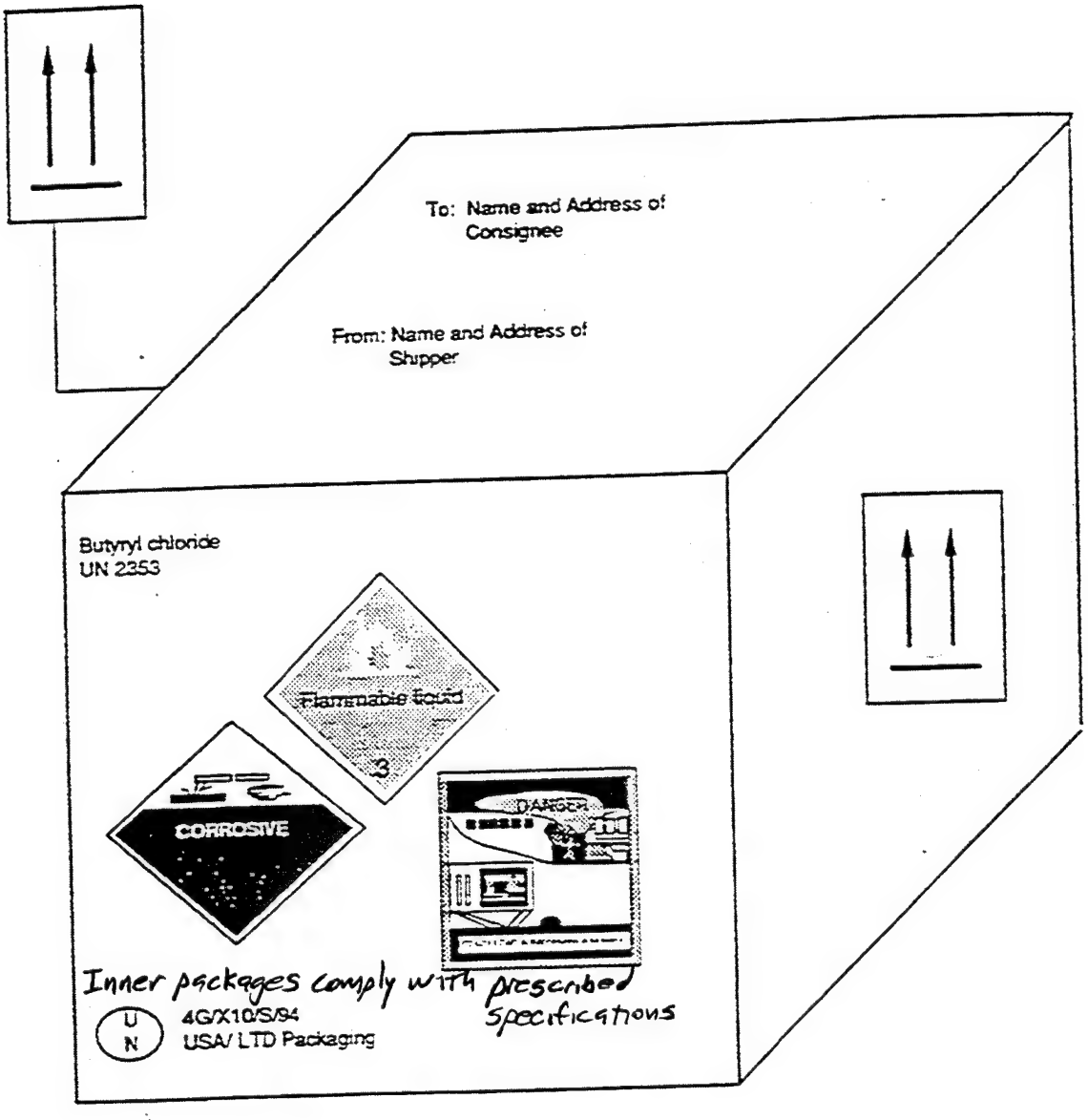
ADDITIONAL HANDLING INFORMATION

TRANSPORT DETAILS	THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR ➡	PASSENGER AIRCRAFT	~~CARGO AIRCRAFT ONLY~~	(DELETE NONAPPLICABLE)
AIRPORT OF DEPARTURE	AIRPORT OF DESTINATION / SHIPMENT TYPE ➡	NON-RADIOACTIVE	~~RADIOACTIVE~~	(DELETE NONAPPLICABLE)

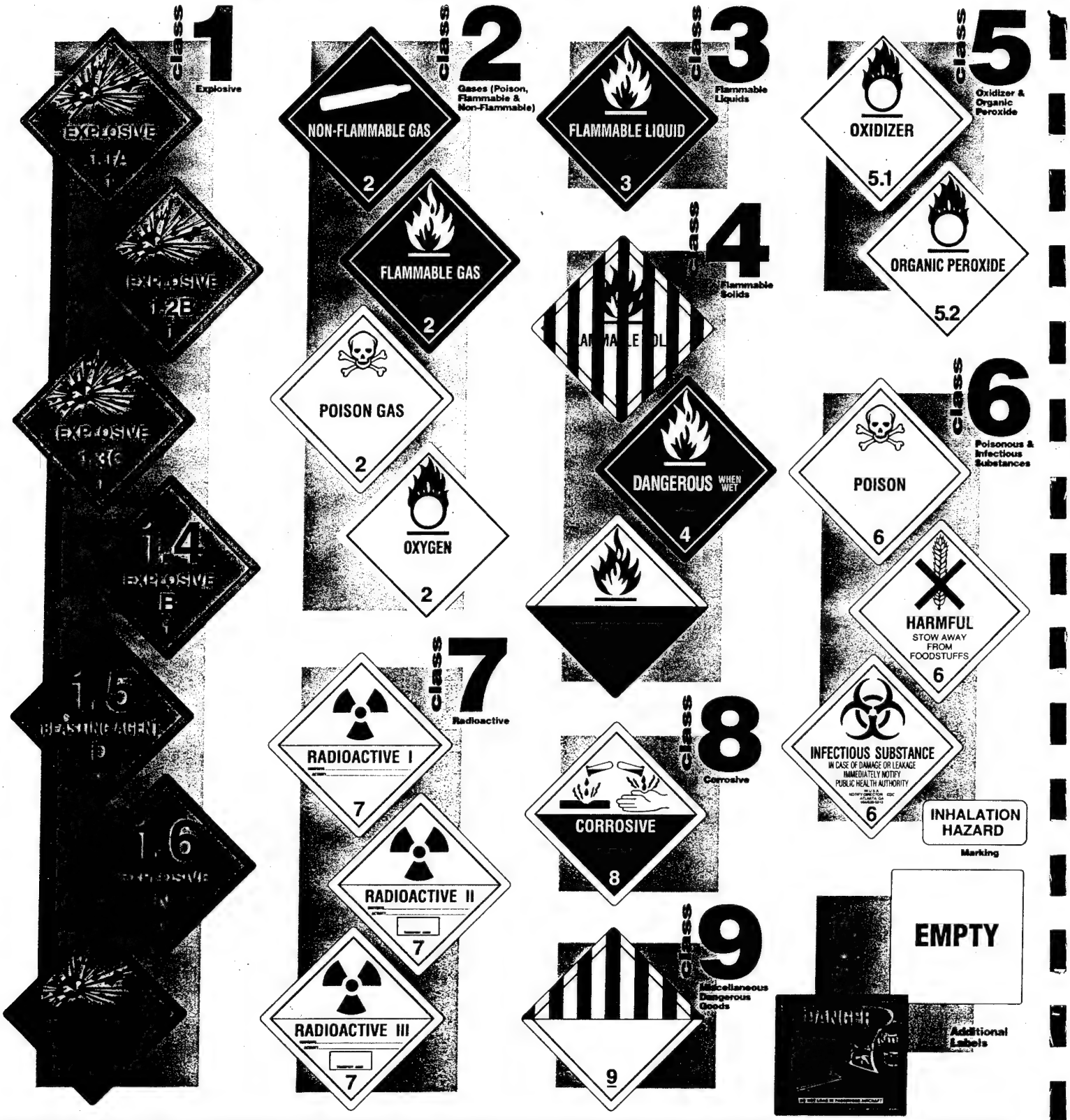
IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS OR TREATMENT.

I HEREBY DECLARE THAT THE CONTENTS OF THIS CONSIGNMENT ARE FULLY AND ACCURATELY DESCRIBED ABOVE BY PROPER SHIPPING NAME AND ARE CLASSIFIED, PACKED, MARKED, AND LABELED, AND ARE IN ALL RESPECTS IN PROPER CONDITION FOR TRANSPORT BY AIR ACCORDING TO THE APPLICABLE INTERNATIONAL AND NATIONAL GOVERNMENT REGULATIONS.

NAME AND TITLE OF SHIPPER: JOHN SMITH, TRAFFIC CLERK
PLACE AND DATE: KNOXVILLE, TN 3/8/94
EMERGENCY TELEPHONE NUMBER: 1-800-321-5479
SIGNATURE OF SHIPPER: John Smith
SEE WARNING ON BACK


To: Name and Address of Consignee
From: Name and Address of Shipper
Butyryl chloride
UN 2353
Flammable liquid
3
CORROSIVE
DANGER
Inner packages comply with prescribed specifications
U N
4G/X10/S/94
USA/ LTD Packaging

New HM-181 Labels



HM-181 is a final rule that comprehensively revises the D.O.T. (HMR) Hazardous Materials Regulations (49 CFR, Parts 171-180) which govern the safe transport of hazardous materials.

HM-181's extensive changes are in response to concern in the industry that the existing regulations were both lengthy and difficult to follow. Critics also pointed to the discrepancies between US D.O.T. regulations and international regulations.

The revised ruling addresses these concerns by making hazardous materials transportation both safer and easier. In addition to being more user-friendly, the revisions bring US regulations into harmony with international regulations.

For further information and updates on HM-181 and how it affects you, call one of our Regulatory Experts at 800-621-5808.

Labels

The new hazardous materials shipping labels measure 100 mm x 100 mm versus the 4" x 4" size previously in use. Like the placarding changes, the new labels are designed to emphasize the hazard symbol. The appropriate hazard class or for division 5.1 and 5.2 class and division number must be displayed in the lower corner of a primary hazard label and may not be diplayed on a susidiary risk label. 49 CFR Subpart E – Labeling, Section 172.400 contains further information on general labeling requirements.

Labelmaster — 1-800-621-5808

Style No. TRAINCRD Printed by Labelmaster, An American Labelmark Co., Chicago, IL 60646 (800) 621-5808

APPENDIX E

HEALTH AND SAFETY PLAN FOR RINSE WATER SAMPLING AT THE LETTERKENNY ARMY DEPOT

HEALTH AND SAFETY PLAN
FOR
RINSE WATER SAMPLING
AT THE
LETTERKENNEY ARMY DEPOT
LETTERKENNEY, PA

Prepared by

IT Corporation
Cincinnati, Ohio

USAEC Contract No DACA 31-91-D-0074
Task Order No. 5
IT Project No. 322244

Revision 0
January 1995

REVIEWS AND APPROVALS

Project Manager
IT Corporation

_____ Date

Health and Safety Coordinator
IT Corporation

Michelle McLeod Date 4/20/95

USAEC Project Manager

_____ Date

Letterkenny Army Depot Project Manager

_____ Date

Letterkenny Army Depot Health and Safety Representative

_____ Date

Site Health and Safety Plan Acknowledgment

I have read, understand and agree to abide by the provisions as detailed in this Site-Specific Health and Safety Plan. Failure of IT employees to comply with these provisions may lead to disciplinary action and/or dismissal from the work site.

Printed Name	Signature	Employee Number	Date

Table of Contents

List of Tables

1.0 Introduction

1.1 Objectives

To obtain samples of water from two process rinse water tanks at Letterkenny Army Depot.

1.2 Facility and Location Description

Letterkenny Army Depot (LEAD), located in Chambersburg, PA, overhauls, rebuilds, and tests wheeled and tracked combat vehicles, missile systems, fire control systems and associated secondary items. As a part of its operations, LEAD utilizes chemical paint strippers. A formulation of methylene chloride and formic acid (commercial name: Penstrip NPX) is used to strip paint from aluminum parts. Parts are dipped in the NPX then rinsed by dipping in a rinse water tank.

Chemical paint stripping operations at LEAD are conducted in Buildings 350 and 370. In building 350, a steam rinse is used to clean the stripped part and evaporate the methylene chloride. The steam and methylene chloride are discharged to the atmosphere. Condensate is discharged to the industrial sewer. In building 370, a hot water rinse is used to clean the stripped part. This tank has an operating volume of 1,000 gallons and is maintained at a temperature of 180° F - 200° F. The tank is presently operated on one 8-hour shift, five days per week. There is no information currently available about the concentration of methylene chloride in the tank.

1.3 Policy Statement

It is the policy of IT Corporation (IT) to provide a safe and healthful work environment for all its employees. No phase of operations or administration is of greater importance than injury and illness prevention. Safety takes precedence over expediency or shortcuts. We believe every accident and every injury is preventable, and will take every reasonable step to reduce the possibility of injury, illness, or accident.

This Health and Safety (H&S) Plan prescribes the procedures that must be followed by IT employees during the sampling activities at the Letterkenny Army Depot. Operational changes which could affect the health or safety of personnel, the community, or the environment will not be made without the prior written approval of the IT Project Manager, the Project H&S Coordinator, and the USAEC, PM Branch, Safety Office.

The provisions of this plan are mandatory for all IT personnel assigned to the project.

1.4 References

This H&S plan complies with applicable Occupational Safety and Health Administration (OSHA) and the U.S. Environmental Protection Agency (U.S. EPA) regulations. This plan follows the guidelines established in the following:

- Standard Operating Safety Guidelines (U.S. EPA, November 1984)
- Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities [National Institute of Occupational Safety and Health (NIOSH)

86-116]

- Title 29 of the Code of Federal Regulations (CFR), Part 1910.120, U.S. Department of Labor (U.S. DOL)/OSHA.

The contents of this plan are consistent with IT H&S policies and procedures.

2.0 Responsibilities

2.1 All Personnel

Each person is responsible for the H&S of themselves and their coworkers, for completing tasks in a safe manner, and reporting any unsafe acts or conditions to their Supervisor and/or the Site Supervisor. All personnel are responsible for continuous adherence to these H&S procedures during the performance of their work. No person may work in a manner that conflicts with the letter or the intent of, or the safety and environmental precautions expressed in these procedures. After due warnings, IT will dismiss from the site any employee who violates safety procedures. IT's employees are subject to progressive discipline and may be terminated for blatant or continued violations. All on-site personnel will be trained and medically qualified in accordance with 29 CFR 1910.120 and this document.

2.2 Project Manager

The Project Manager is ultimately responsible for ensuring that all project activities are completed in accordance with requirements set forth in this plan. The Project Manager must perform at least one on-site safety review during the project. The Project Manager is responsible for ensuring all accidents and incidents on the project are reported and thoroughly investigated. The Project Manager must approve in writing any addenda or modifications of the H&S plan.

2.3 Project Health and Safety Coordinator

The Project H&S Coordinator is responsible for the preparation and modification of this H&S plan. Any changes to the H&S plan must be approved by the Project H&S Coordinator. The Project H&S Coordinator will advise the Project Manager on H&S issues, will establish and oversee the project air monitoring program. The H&S Coordinator is the designated regulatory contact on matters related to occupational H&S.

2.4 Site Supervisor

The Site Supervisor will be responsible for field implementation of the H&S plan. This will include communicating site requirements to all on-site project personnel and consultation with the Project H&S Coordinator. As required by IT Policy and Procedure HS022, the Site Supervisor will be responsible for informing the Project H&S Coordinator and the Project Manager of any changes in the work plan, so that those changes may be properly addressed. Other responsibilities include:

- Enforcing the requirements of the H&S plan. This includes performing daily site safety walks of the work site.
- Stopping work, as required, to ensure personal safety and protection of property, or where life or property-threatening noncompliance with safety requirements is found.
- Determining routes to capable medical facilities and emergency telephone numbers (including poison control facilities) and arranging emergency

transportation to medical facilities.

- Observing on-site project personnel for signs of chemical or physical trauma.

- Ensuring that all site personnel have been given the proper medical clearance, ensuring that all site personnel have met appropriate training requirements and have the appropriate training documentation on site, and monitoring all team members to ensure compliance with the H&S plan.

2.5 Subcontractors

Subcontractors will not be used during this task.

2.6 On-Site Personnel and Visitors

All IT personnel are required to read and acknowledge their understanding of this H&S plan. All site project personnel are expected to abide by the requirements of the plan and cooperate with site supervision in ensuring a safe and healthful work site. Site personnel are required to immediately report any of the following to the Site Supervisor:

- Accidents and injuries, no matter how minor
- Unexpected or uncontrolled release of chemical substances
- Any symptoms of chemical exposure
- Any unsafe or malfunctioning equipment
- Any changes in site conditions which may affect the H&S of project personnel.

3.0 Job Hazard Analysis

3.1 Scope of Work
A single technician will sample daily over a period of several weeks the wastewater from two rinse tanks.

3.2 Job Hazard Assessment
The temperature of the rinse water is 180^0 F, it has a pH of 3.2 or less. The liquid in the tanks will be gently and manually stirred, prior to sampling. A sample will then be taken using a groundwater type sampling bailer. A fixed permanent ladder is required to access the liquid in one of the tanks. Sampling locations are indoors. The area in Building 350 is posted where noise hazards exist.

3.3 Physical Hazards
Anticipated physical hazards of concern:

- Heat (hot surfaces and liquids)
- Noise
- Fall, trip, slip

The primary safety hazards for this project are associated with the collection of samples from open top tanks.

3.3.1 Heat (hot surfaces and liquids)
The water and tanks are heated to 180^0 F. Heat and chemical resistant gloves and goggles are to be added to normal Level D PPE requirements during sampling activities. When sampling the hot liquid extreme care must be taken to gently lower the stirring rod and bailer into the tank to avoid splashing.

3.3.2 Noise
Noise exposure at or above the OSHA action level (85 decibels [dBA]) may be encountered during this task. IT's hearing conservation program is reviewed during the 8-hour OSHA refresher each year. Signs are posted (i.e. Building 350) where noisy conditions exist. Hearing protection shall be worn in these areas.

Exposure to noise over the OSHA action level can cause temporary impairment of hearing; prolonged and repeated exposure can cause permanent damage to hearing. The risk and severity of hearing loss increases with the intensity and duration of exposure to noise. In addition to damaging hearing, noise can impair voice communication; thereby, increasing the risk of accidents on site.

3.3.3 Slip, Trip and Fall
Water, especially caustic water, can cause floors and steps to become slippery. These hazards shall be noted in the Tailgate Safety Meeting (TGSM), conducted at the beginning of each week or whenever the task changes. The location of safety equipment on site (i.e. safety showers, eye wash) as well as areas of known potential hazards shall be noted on the TGSM. The TGSMs are to be reviewed by the project manager on a weekly basis prior to

their entry into the project file.

3.4 Chemical Hazards

The chemical hazards associated with the rinse water sampling operations at the Letterkenny Army Depot are related to inhalation, ingestion, and skin contact with contaminated liquids (Table 1). The site-specific Material Safety Data Sheets (MSDS) are included in Appendix A. No hazardous chemicals will be taken on site. The following chemical hazards are associated with the rinse water:

- Formic Acid
- Methylene Chloride (Dichloromethane)
- Used paint sludge (No MSDS exists for this particular material, and anticipated/potential hazards are listed in Table 1.)

Please note that Formic Acid and Methylene Chloride have poor warning properties. The use of a 1/2 face respirator with acid/organic cartridges is required during the sampling task. Cartridges will be changed at the end of each shift. This requirement may be changed after completion of air monitoring.

3.5 Anticipated Biological Hazards

No biological hazards are anticipated.

Table 1
Chemical Hazard Information

Contaminant (Synonym)	Physical/Chemical Characteristics (Target Organs/Route of Entry)	OSHA PEL (ppm)	ACGIH (ppm)
Formic Acid	A colorless fuming liquid with a pungent, irritating odor. Poor warning properties, odor threshold is above the TLV. Primary routes of entry: Inhalation, skin and eye contact, ingestion.	5 ppm	5 ppm STEL 1(
Methylene Chloride	Colorless liquid with a penetrating ether like odor. Poor warning properties, odor threshold is above the TLV. Primary routes of entry: Inhalation, skin and eye contact, ingestion.	500 ppm STEL 2000 ppm Ceiling 1000 ppm	50 ppm suspecte human carcinog
Paint (waterbased)	Opaque paint may be an inhalation or skin hazard and a minor flammability hazard.	25 ppm for most hazardous component	no data

4.0 Safety Program and Procedures

The following work practices will be observed during all site activities.

4.1 General Practices

- At least one copy of this plan shall be available at the project site, in a location readily available to all personnel, including visitors.
- As practical, personnel should practice contamination avoidance. All samples should be collected in such a manner as to minimize contact with the material.
- Contaminated protective equipment, such as respirators, etc., shall not be removed from the area of potential contamination until cleaned or properly packaged and labeled.
- Legible and understandable precautionary labels which comply with the hazard communication standard shall be affixed prominently to any container of contaminated material.
- Removal of contaminated solids from protective clothing or equipment by blowing, shaking, or any other means that disperse contaminants into the air is prohibited.
- No food or beverages shall be present or consumed in the sampling area.
- No tobacco products shall be present or used in the sampling area.
- Cosmetics shall not be applied within the sampling area.
- Contaminated materials shall be stored in tightly closed containers, in well-ventilated areas.
- Ensure that no one is required to lift more than 60 pounds.

4.2 Heat and Cold Stress Prevention

All work shall be completed in a temperature controlled environment.

4.3 Hearing Conservation

All on-site IT personnel shall wear hearing protection, with a Noise Reduction Rating (NRR) of at least 20, when noise levels exceed 85 dBA. All site personnel who may be exposed to noise shall also receive baseline and annual audiograms and training as to the causes and prevention of hearing loss. Noise monitoring is discussed in Chapter 8.0. Noise is associated with normal department activities. Noise generating sampling equipment will not be used.

5.0 Personal Protective Equipment (PPE)

Based upon the job hazard analysis, it is expected that project personnel will utilize a Modified Level D PPE during sampling. If conditions warrant a higher level of protection (Table 2), site work will be suspended until such conditions can be rectified and the H&S Plan modified.

Table 2
PPE Selection Matrix
AIRBORNE CONTAMINANT ACTION LEVELS

Parameter	Reading	Action
Identified Air Contaminant	<1/2 x PEL	Level D
	<10 x PEL	Level C
	>10 x PEL	Level B

5.1 Modified Level D

The minimum level of protective equipment to be worn on site is:

Hard hat, American National Standards Institute (ANSI) approved
Safety glasses with side shields, ANSI approved
Steel-toed boots or shoes, ANSI approved
Long pants and long-sleeved shirt

During sampling activities the following additional protective equipment is required:

- Heat and chemical resistant gloves (e.g. 22 oz. Thermobest, 8 oz. Kevbest cuff, Arabest patch, heavy wool lined, 14 inch long)
- 1/2 face respirator with organic vapor/ acid gas cartridges
- Goggles (A full face respirator may be substituted for goggles and 1/2 face respirator.)
- Neoprene splash apron with sleeves
- Hearing protection with a U.S. EPA NRR of at least 20 dBA shall be used in Building 350.

5.2 Respiratory Protection Program

The IT respiratory protection program will apply to all activities requiring the use of respirators at the site. Basic requirements are as follows:

All site personnel will have an assigned respirator face piece.

All site personnel will have been medically qualified, fit tested, and qualified in the use of the appropriate respirator within the past 12 months. Fit test and respirator qualification cards must be provided to the Site Supervisor prior to

commencing site work.

Only properly cleaned, maintained, NIOSH-approved respirators shall be used.

The respirator cartridge is to be disposed of at the end of each work shift, or when breakthrough occurs.

Contact lenses are not to be worn when a respirator is required.

All site personnel will be clean shaven in facial areas which touch the sealing surface of the respirator.

Respirators will be inspected; a positive and negative pressure test will be performed prior to each use.

After each use, the respirator will be wiped with a disinfectant, cleansing wipe. When used, the respirator will be thoroughly cleaned at the end of the work shift. The respirator will be stored in a clean plastic bag.

5.3 Using Personal Protective Equipment

Specific donning and doffing procedures are not required.

6.0 Site Control

Only IT personnel who have completed 40 hours of hazardous waste operations as defined under OSHA Regulation 29 CFR 1910.120, have completed their 40-hour training or refresher training within the past 12 months, and have been certified as fit for hazardous waste operations by a physician within the past 12 months shall be allowed within the sampling area.

6.1 Hazard Briefing

No person will be allowed on any IT field site without first being given a site hazard briefing. In general, the briefing will consist of a review of the tailgate safety meeting. All persons on the site must read and sign the site-specific tailgate safety meeting form and H&S Plan.

6.2 Documentation of Certification

A training and medical file will be established for the project and kept at the IT Cincinnati office during all site operations. The 40-hour training, update, and specialty training (first-aid/cardiopulmonary resuscitation [CPR]) certificates, as well as the current annual medical clearance for all project field personnel, will be maintained within that file.

6.3 Entry Log

The IT representative shall record on their Field Activity Daily Log (FADL) all visitors to the site.

6.4 Entry Requirements

In addition to the entry requirements listed above, no IT personnel will be allowed to conduct sampling unless they are wearing the minimum PPE as described in Section 5.0. Personnel entering the sampling area must wear the required PPE for that location.

7.0 Decontamination

7.1 Personnel Decontamination

Personnel will thoroughly wash their hands and face before leaving the site. Respirators will be sanitized and then placed in a clean plastic ziplock bag.

7.2 Equipment Decontamination

Sampling equipment (e.g., bailer, stirring tool, etc.) will be rinsed with clean tap water after use. Vehicle decontamination is not required for this task.

7.3 Personal Protective Equipment Decontamination

Respiratory and other reusable protective equipment will be wiped with a damp cloth after use and bagged. Once the equipment has been removed from the sampling area it will be thoroughly cleaned with soap and water. The respirator face piece will be cleaned at the end of each work shift.

8.0 Site Monitoring

8.1 Air Monitoring

Air monitoring is essential to ensure that all field personnel are adequately protected from airborne contaminants.

8.1.1 Locations to be Monitored

Personnel breathing zones will be monitored, using Dräger tubes, for methylene chloride and formic acid prior to sampling and after stirring of the contents of the tank **Data will be faxed to the HS Coordinator as soon as monitoring is complete.**

8.1.2 Frequency

Personal air monitoring samples shall be collected during the first full day of site sampling operations. Based on these initial results, the frequency of additional sample collection and analysis will be determined by the H&S Representative, and the appropriate level of personal protection will be reviewed.

8.1.3 Air Monitoring Equipment

Dräger pump and tubes to monitor Formic acid and Methylene chloride will be available for on-site utilization as required.

8.1.4 Monitoring Equipment Maintenance and Calibration

All monitoring equipment used will be calibrated in accordance with IT Procedure HS603. Preventive maintenance and repairs will be conducted in accordance with the respective manufacturers' procedures (Table 3).

Table 3
Calibration and Maintenance of Field Sampling Equipment

Monitor Type	Calibration Method	Calibration Frequency	Maintenance Schedule
Dräger tube sampling system	Check air tightness of pump by inserting unbroken tube. Compress bellows pump, time for one minute, chain should remain slack. If chain taut, then maintenance required.	Check daily prior to start of workday.	Maintenance required whenever pump fails to pass leak test. Replace seals and/or lubricate per instruction manual.
Sound level meter	Calibrate using known noise source (manufacturer supplied acoustic calibrator). Check battery level within recommended limits.	Calibrate meter and check battery daily prior to use.	Annual cleaning by qualified technician. Maintenance required if meter fails to calibrate.

All direct reading instrumentation calibrations should be conducted under the approximate environmental conditions the instrument will be used. All air monitoring equipment calibrations and maintenance activities shall be documented on the IT FADL, or equivalent. All completed H&S documentation/forms shall be reviewed by the Project H&S Coordinator and maintained by the Site Supervisor.

If an instrument is found to be inoperative or suspected of giving erroneous readings, the IT H&S Representative shall be responsible for immediately removing the instrument from service and obtaining a replacement unit. The operation for which this equipment is essential shall cease until an appropriate replacement unit is obtained.

8.2 Noise Monitoring

Noise monitoring is not anticipated on this project, however it may be performed if noise levels that interfere with speech are encountered in non-posted areas.

8.3 Safety Review

At least once during the project, the Project Manager will carry out a comprehensive safety review of the project. The Site Supervisor will conduct frequent site safety inspections (no less than once per week). Management safety reviews will be recorded on Safety Inspection Report Forms and will be forwarded to the H&S coordinator for review. The Site Supervisor will record the inspection results on the Safety Inspection Report.

8.4 Monitoring Records

The Project Manager shall ensure that site monitoring records are complete and incorporated into the project file. Copies of site monitoring records shall be provided to USAEC, PM Branch, Industrial Hygiene Office, MCXR-LK-IH, Bldg. 2, whenever an incident occurs that require some form of action (i.e., upgrade in PPE, elevated exposure levels, etc.) during field activities. It is acceptable to facsimile copies to PM Branch, Safety Office at (410) 612-6836. Any personnel or area air monitoring results will be incorporated into the host office H&S files and individual employee files:

- Employee name, social security number, payroll number
- The date, time, pertinent task information, exposure information
- Description of the analytical methods, equipment used, and calibration data
- Type of PPE worn
- Engineering controls used to reduce exposure.

8.5 Notification

Within five working days after receipt of monitoring results, the project H&S staff and the host office H&S staff will ensure that each employee is informed in writing of the results which represent that employee's exposure. Monitoring results representative of an employee's exposure shall be reported to the affected employee on the IT Employee Notification of Industrial Hygiene Monitoring Results Form.

Whenever the results indicate that exposure exceeded the PEL, the Employee Notification of Industrial Hygiene Monitoring Results Form shall state that the PEL was exceeded, and shall provide a description of the corrective action taken to reduce exposure to a level below the PEL.

9.0 Employee Training

9.1 General

All on-site IT personnel shall have completed at least 40 hours of hazardous waste operations-related training, as required by OSHA Regulation 29 CFR 1910.120. All field employees receive a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor. Those personnel who completed the 40-hour training more than 12 months prior to the start of the project shall have completed an 8-hour refresher course within the past 12 months.

9.2 Tailgate Safety Meetings

Prior to the start of the project, IT personnel will participate in a tailgate safety meeting during which the H&S plan will be discussed. The Site Supervisor will ensure that the anticipated site hazards are summarized and explained to all personnel, and that personnel are aware of the precautions they must take to minimize exposure to hazards. Tailgate safety meetings will be held at the start of each work shift. All employees must attend the meeting and be familiar with this H&S Plan. Attendance records and meeting notes are maintained with the project files.

9.3 Material Safety Data Sheets

The MSDSs for chemical substances anticipated to be encountered during sampling are included in Appendix A. The H&S plan is maintained on site and is accessible to all site employees.

9.4 Site-Specific Health and Safety Plan

The IT safety department prepares a site-specific H&S plan for each project falling within the scope and application of 29 CFR 1910.120 and IT Procedure HS052. Injury and illness prevention programs are written for all other projects. The Site Supervisor presents the H&S plan and discusses it with all personnel assigned to the project. All workers and visitors must read and sign the H&S plan acknowledging acceptance of site rules and understanding of site hazards before the start of the site work.

9.5 First Aid and Cardiopulmonary Resuscitation

At least one employee current in first aid/CPR will be assigned to the work crew and will be on the site whenever operations are ongoing.

10.0 Medical Surveillance Program

10.1 Physical Examinations

All on-site project personnel shall have completed a comprehensive medical examination that meets the requirements of OSHA's Regulation 29 CFR 1910.120 within the past 12 months. All employee medical records are maintained by the H&S group within the worker's home office. Each employee also has the right to inspect and copy medical records.

10.1.1 Preplacement Examination

All employees will receive a preplacement medical examination prior to assignment to field operations.

10.1.2 Annual Examination

All employees undergo an annual examination similar in scope to the placement examination. IT employees hired prior to 1985 are not required to submit to drug screening. Chest X-rays are taken every third year. The medical and occupational history is updated with each examination.

10.2 First-Aid and Medical Treatment

All IT employees on site must report any near-miss incident, accident, injury, or illness to their immediate supervisor or the Field Supervisor. First aid will be provided by the designated site first aider. Injuries and illnesses requiring medical treatment will be accompanied by an "Authorization for Treatment" Form. The employee's supervisor or the Field Supervisor will complete the "Supervisor's Employee Injury Report" and conduct an accident investigation as soon as emergency conditions no longer exist and first-aid and/or medical treatment has been rendered. The investigation should follow the Accident/Injury Investigation Report. These two reports must be completed and submitted to the H&S Coordinator within 24 hours after the incident.

If first-aid treatment is required, first-aid is available on site. If treatment beyond first aid is required, the injured should be transported to the medical facility shown in Appendix B. If the injured is not ambulatory or shows any sign of not being in a comfortable and stable condition for transport, then an ambulance/paramedics should be summoned. If there is any doubt as to the injured worker's condition, it is best to let the local paramedic or ambulance service examine and transport the worker.

10.3 Medical Records

Medical and personal exposure monitoring records will be maintained according to the requirements of 29 CFR 1910.20 and HS103, and shall be kept for 30 years post employment. Employee confidentiality shall be maintained. Employees and their authorized representatives have access to these records through the H&S Assistant.

11.0 Emergency Response Plan

11.1 General

This H&S plan has been developed to allow the operation to be conducted without adverse impact to the H&S of project personnel, other personnel, and the environment. Supplementary procedures are included in this section to address extraordinary conditions that might occur at the site.

11.2 Emergency Procedures

If an incident occurs, the following procedures will be used:

- The Site Supervisor will evaluate the incident and assess the need for assistance
- The Site Supervisor will immediately notify the LEAD escort and/or the shop supervisor
- The Site Supervisor will ensure the Project Manager and an H&S Representative are promptly notified of the incident
- The Site Supervisor will assist the LEAD staff in stabilizing the incident scene.

11.3 Medical Emergency

All employee injuries must be promptly reported to the IT Site Supervisor and LEAD escort. The Site Supervisor will:

- Ensure that the injured employee receives prompt first aid and medical attention
- Ensure that the Project Manager and General Manager are promptly notified of the incident
- Initiate an investigation of the incident.

11.3.1 Chemical Inhalation

Any employee complaining of symptoms of chemical overexposure as described in Chapter 3.0 will be removed from the work area and transported to the designated medical facility for examination and treatment. It is highly unlikely that the chemicals anticipated as being on site, in the concentrations anticipated, would cause situations immediately dangerous to life and health.

11.3.2 Eye Contact

Project personnel who have had contaminants splashed in their eyes or who have experienced eye irritation while in the sampling area, shall immediately proceed to the eyewash station. Do not decontaminate prior to using the eyewash. Remove whatever protective clothing is necessary to use the eyewash. Flush the eye with clean running water for at least 15 minutes. Arrange prompt transport to the designated medical facility. IT personnel and subcontractors are prohibited from wearing contact lenses on USAEC

sites at any time.

11.3.3 Skin Contact

Project personnel who have had skin contact with contaminants will remove any contaminated clothing and rinse the affected area with water for at least 15 minutes. Plant tap water is available at the sampling location. The worker should be transported to the medical facility listed below, if they show any sign of skin reddening, irritation, or if they request a medical examination.

11.3.4 Personal Injury Accident

In the event of a personal injury accident, the Site Supervisor will assess the nature and seriousness of the injury. In the case of serious or life-threatening injuries, normal decontamination procedures may be ignored. Less serious injuries such as strains, sprains, minor cuts, and contusions may only be treated after the employee has been decontaminated (i.e., rinsed with tap water).

Following decontamination, an IT project team member qualified in first aid and CPR will administer suitable first aid. The Site Supervisor will then, if necessary, arrange transport to the appropriate medical facility.

Accidents resulting in any fatality, lost time injury or illness, hospitalization of 3 or more personnel, or property damage to Government or contractor property (which occurred during the performance of the contract) equal to or exceeding $2000.00 must be reported by telephone to the U.S. Army Environmental Center (USAEC), SFIM-AEC-ETP, (410) 671-4811, within 8 hours of occurrence.

11.4 Fire

Any fires will be immediately reported to the LEAD escort.

11.5 Emergency Information

Prior to the start of the project, the LEAD escort will review emergency services and familiarize the project personnel with the communication procedure and services in each building.

11.5.1 Public Agencies

Fire		911
Ambulance		911
Police		911
Hospital	Chambersburg Hospital	717-264-5171
	112 North 7th Street, Chambersburg PA	

Exit at the Letterkenny Road Gate. Letterkenny Road turns into Franklin St. At the first stop sign on Franklin Street, turn left onto Kings Street. Go through two stop lights and four stop signs. The hospital will be on the right.

11.5.2 Key Project and IT Personnel

Project Director	Bob Hoye	513-782-4700
Project Manager	Rajib Sinha	513-782-4700
H&S Coordinator	Michelle McLeod	513-782-4700
Site Supervisor	Frank Kelly	513-782-4700
IT Office General Manager	Noel Hurley	513-782-4700
Occupational Physician:	Dr. Ross Myerson	
	Washington Occupational Health Associates	
		800-777-9642
	FAX	800-865-6525
LEAD Contact	Todd Johnson	717-267-8670
USAEC Project Officer	James Heffinger, Jr.	410-612-6846
USAEC Safety Officer	William Houser	410-612-6866

APPENDIX A

CHEMICAL INFORMATION

APR-07-1994 13:24 FROM PROD ENGINEERING DIV TO 9151376248 P.01/02

Budget Bureau No. 44-R1387
Approval Expires April 30, 1971

U.S. DEPT.

WAGE AND LABOR S
Bureau of

MATERIAL S

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL # of pages ▸ 2

To Bob Hoye	From Todd Johnson
Dept./Agency IT Corporation	Phone # 717-267-9506
Fax # 913-782-4807	Fax # 717-267-9299

NSN 7540-01-317-7364 5099-101 GENERAL SERVICES ADMINISTRATION

SECTION I

MANUFACTURER'S NAME: PENETONE CORPORATION	EMERGENCY TELEPHONE NO.: (201) 567-3000
ADDRESS (Number, Street, City, State, and ZIP Code): 74 Hudson Avenue, Tenafly, NJ 07670	
CHEMICAL NAME AND SYNONYMS: NA	TRADE NAME AND SYNONYMS: PEN-STRIP NPX
CHEMICAL FAMILY: Remover of organic coatings	FORMULA: NA

SECTION II HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS Dichloromethane	70	500	FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Formic Acid	25	5

SECTION III PHYSICAL DATA

BOILING POINT (°F.)	110	SPECIFIC GRAVITY (H_2O=1)	1.26
VAPOR PRESSURE (mm Hg.)	--	PERCENT VOLATILE BY VOLUME (%) @ 105°C approx	72
VAPOR DENSITY (AIR=1)	4	EVAPORATION RATE (CCl4 = 1)	20
SOLUBILITY IN WATER	Partial		

APPEARANCE AND ODOR: Amber liquid with pungent acid odor

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	None (C.O.C., T.O.C.)	FLAMMABLE LIMITS	NA

	Lel	Uel

EXTINGUISHING MEDIA: NA

SPECIAL FIRE FIGHTING PROCEDURES: Use gas masks

UNUSUAL FIRE AND EXPLOSION HAZARDS: Decomposition can occur producing hydrogen chloride and chlorine

PEN-STRIP NPX

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: See Section II

EFFECTS OF OVEREXPOSURE: Weakness, headache, dizziness, rapid breathing, loss of consciousness in extreme cases. Skin and eyes - can cause severe burns upon contact.

EMERGENCY AND FIRST AID PROCEDURES: Overexposure - remove to fresh air, apply artificial respiration if necessary. Call physician. EYES - immediately wash with water for 10 minutes; consult a physician. SKIN- immediately wash with water ~~and sodium bicarbonate solution~~. Consult a physician in case of burns.

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	

INCOMPATABILITY (Materials to avoid): Do not mix with alkalics. Damages rubber and plastics

HAZARDOUS DECOMPOSITION PRODUCTS: None

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Provide adequate ventilation. Rinse with water; avoid contact with eyes, skin, and clothing. Immediately remove contaminated clothing, wash skin thoroughly. Wash clothing before reuse.

WASTE DISPOSAL METHOD: Obtain services of a scavenger. Do not dump into waterways.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): Not normally required

VENTILATION	LOCAL EXHAUST	Floor level exhaust fan	SPECIAL: Use in well-ventilated areas only.
	MECHANICAL (General)		OTHER

PROTECTIVE GLOVES: Neoprene rubber gauntlets

EYE PROTECTION: Goggles, glasses or face shield

OTHER PROTECTIVE EQUIPMENT: Rubber apron

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Store in tightly closed containers in a cool area. Avoid skin and clothing contact with product.

OTHER PRECAUTIONS: When opening container, vent drum slowly to release possible internal pressure. Keep face away when opening. Do not heat the product.

* *
* M S D S *
* Canadian Centre for Occupational Health and Safety *
* * * * * * * * * * * * * * Issue : 95-1 (February, 1995) *

*** IDENTIFICATION ***

MSDS RECORD NUMBER : 798249
PRODUCT NAME(S) : FORMIC ACID
PRODUCT IDENTIFICATION : VAN WATERS & ROGERS MSDS NO.: L1290
DATE OF MSDS : 1993-04-12

*** SUPPLIER/DISTRIBUTOR INFORMATION ***

SUPPLIER/DISTRIBUTOR : VAN WATERS & ROGERS LTD
ADDRESS : 9800 Van Horne Way
Richmond British Columbia
Canada V6X 1W5
EMERGENCY TELEPHONE NO. : 800-424-9300 (CHEMTREC)

*** MATERIAL SAFETY DATA ***

L1290.1 FORMIC ACID

VAN WATERS & ROGERS LTD. 9800 VAN HORNE WAY RICHMOND, B.C. V6X 1W5

WHMIS CODES: B.3 D.1B E

----------EMERGENCY ASSISTANCE----------

For Emergency Assistance Involving Chemicals
Call CHEMTREC (800) 424-9300

----------PRODUCT INFORMATION----------

Product Name: FORMIC ACID VW&R Code: L1290

Common Name/Synonym: Methanoic Acid; Formylic Acid; Hydrogen Carboxylic Acid; Amnic Acid
CAS Registry Number: 64-18-6
Chemical Name: N/D
Chemical Family: Carboxylic Acid, Aliphatic
Formula: C-H2-O2
Molecular Weight: 46.03
Product Use: Manufacture of fumigants, insecticides, refrigerants, solvents for perfumes, lacquers; electroplating; brewing, ore flotation; vinyl resin plasticizers.

----------PREPARATION INFORMATION----------

Date Issued: 02/93
Supercedes: 01/90 (P1242)
Prepared By: MSDS Coordinator. Contact during business hours, Pacific Time (604)-273-1441.

----------HAZARDOUS INGREDIENTS----------

Component(s)/CAS No.	% wt.	Exposure Limits, ppm OSHA PEL	ACGIH TLV
Formic Acid (64-18-6)	85-98	5	5
Water (7732-18-5)	1-15	N/D	N/D

Local regulated limits may vary.

PHYSICAL PROPERTIES

Boiling Point: 100.6 C (213.01 F)
Melting Point: N/AP
Freezing Point: N/D
Specific Gravity (Water=1): 1.20
Vapour Pressure: 44.80 M.BAR at 20 C
Vapour Density (air=1): 1.6
Viscosity: 1.8 CP at 20 C
pH: N/D
Solubility in Water: Complete
% Volatile: N/AP
Evaporation Rate (Butyl Acetate=1): N/D
Odour Threshold: N/D
Coefficient of Water/Oil Distribution: N/D
Appearance and Odour: A colourless, fuming liquid with a pungent, irritating odour.
Physical State: Liquid.

FIRE AND EXPLOSION INFORMATION

Flash Point/Method: 50.00 C (122 F), CC
Lower Flammable Limit: 18.0 (% by volume)
Upper Flammable Limit: 57.0 (% by volume)
Autoignition Temperature: 435.00 C (813 F)

Extinguishing Media: Use a water spray, dry chemical, "alcohol" foam, all purpose foam or carbon dioxide to extinguish fire.

Special Fire Fighting Procedures: Use a water spray to cool fire-exposed containers, structures and to protect personnel. If leak or spill has not ignited, ventilate area and use water spray to disperse gas or vapour and to protect personnel attempting to stop a leak. Use water to dilute spills and to flush them away from sources of ignition. Do not flush down public sewers.

Exposed firefighters should wear full protective equipment. Certain situations may require the use of MSHA/NIOSH approved self-contained breathing apparatus with full face piece.

Unusual Fire and Explosion Hazards: Irritating or toxic substances may be emitted upon thermal decomposition. Dangerous when exposed to heat or flame. Runoff to sewer may cause fire or explosion hazard. Containers may explode in heat of fire.

"Hazardous Substance Contingency Plan", activate its procedures.

Take immediate steps to stop and contain the spill. Caution should be exercised regarding personnel safety and exposure to the spilled material. For technical advice and assistance related to chemicals, contact CHEMTREC (800/424-9300) and your local fire department. Notify applicable government agencies, if required. Keep unnecessary people away. Stay upwind; keep out of low areas. Isolate hazard area and deny entry. (Also see personal protective equipment.)

Do not touch spilled material. Stop leak if you can do it without risk. Small Spills: Take up with sand or other noncombustible absorbent material or other sorbent known to be compatible, then flush area with water. Small Dry Spills: Shovel into dry containers and cover; move containers; then flush area with water. Large Spills: Dike far ahead of spill for later disposal.

Notification: It may be legally required to report any spill or other release, or substantial threat of release, of this material to the air, water, or land to the appropriate government authorities. Failure to report may result in substantial civil and criminal penalties.

Waste Disposal Method: This substance, when discarded or disposed of, is a hazardous waste. The transportation, storage, treatment, and disposal of this waste material must be conducted in compliance with all applicable government regulations. Disposal can occur only in properly permitted facilities. Check federal, provincial and local regulations for any additional requirements.

Storage and Handling Precautions and Equipment: Store in tightly closed containers in cool, dry, isolated, well-ventilated area away from heat, sources of ignition and incompatibles. Do not eat, drink or smoke in areas of use or storage.

Empty containers may contain toxic, flammable/combustible or explosive residue or vapours. Do not cut, grind, drill, weld or reuse containers unless adequate precautions are taken against these hazards. Assure that proper personal protection measures are taken when opening or entering confined storage vessels.

Special Shipping Information: N/D

Other Precautions

Product Hazard Summary

Health:	Danger! Harmful or fatal if swallowed or inhaled. Causes severe irritation and burns to skin and eyes. Vapours cause severe respiratory tract irritation.
Flammability:	Caution! Combustible liquid and vapour.
Reactivity:	Danger! Stable -- oxidizer: subject to violent reactions.

----------REGULATORY INFORMATION----------

TDG Classification

Shipping Name: Formic Acid
UN: 1779

Hazardous Combustion Products: N/D
Explosion Data
Sensitivity to Mechanical Impact: N/D
Sensitivity to Static Discharge: N/D
Conditions of Flammability: N/D

----------HAZARDOUS REACTIVITY----------

Stability: Stable under normal conditions of use.
Hazardous Polymerization: N/D
Conditions to Avoid: N/D
Materials to Avoid: Avoid contact with oxidizers and reducing agents.

Hazardous Decomposition Products: Irritating and toxic fumes may be emitted upon decomposition. Combustion may produce CO and CO2. Formic acid, particularly at 98% will decompose slowly during storage liberating carbon monoxide which can rupture sealed containers. Certain salts and mineral acids will catalyse the reaction and temperature will increase the rate of decomposition.

Conditions of Reactivity: N/R

----------FIRST AID MEASURES----------

If Inhaled: Remove exposed person from source of exposure. If not breathing, ensure open airway and institute cardiopulmonary resuscitation (CPR). If breathing is difficult, administer oxygen if available. Keep affected person warm and at rest. Get immediate medical attention.

In Case of Eye Contact: Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Get immediate medical attention.

In Case of Skin Contact: Wash area of contact thoroughly with soap and water. Remove contaminated clothing immediately. Get immediate medical attention. Discard contaminated clothing and leather goods.

If Ingested: DO NOT INDUCE VOMITING. If victim is conscious, give 1-3 glasses of water or milk to dilute stomach contents. Keep affected person warm and at rest. Get immediate medical attention.

Notes to Physician: Inhalation - Delayed pulmonary edema may occur, and patient should be maintained under observation for this complication. Ingestion - The agent is an acid corrosive and produced coagulative necrosis of the buccal cavity, esophagus and stomach. The major causes of death are circulatory shock, asphyxia due to glottic or laryngeal edema, perforation of the esophagus or stomach. While treatment of acute ingestion is controversial, induction of emesis and the use of carbon dioxide producing anti-acids are contraindicated. Nasal gastric intubation should be undertaken only with the risk of perforation recognized in contrast to the value of gastric aspiration and lavage. Late complications may include esophageal, gastric or pyloric stenosis.

----------HEALTH HAZARD INFORMATION----------

Primary Routes of Exposure: Inhalation, skin and eye contact, ingestion.

Signs, Symptoms and Effects of Exposure
Inhalation: May cause respiratory tract irritation, burns, coughing,

frothy sputum, difficulty in breathing, fatigue and pulmonary edema.

Eye Contact: EXTREMELY IRRITATING AND CORROSIVE. Direct contact may cause conjunctivitis, redness, pain, blurred vision, conjunctival and corneal destruction and permanent injury. Exposure to vapours or fumes may cause irritation.

Skin Contact: EXTREMELY IRRITATING AND CORROSIVE. Contact may cause reddening, itching, inflammation, burns, blistering and tissue damage. May also cause brownish or yellowish stains on the skin. Skin burns may be deep and healing will be slow with scar formation.

Ingestion: SLIGHTLY TOXIC. CORROSIVE. May cause burning pain of the mouth, throat, and abdomen and coughing and constriction of the throat, followed by nausea, abdominal spasms, vomiting, hematemesis and diarrhea. May also cause shock, breathing difficulties and kidney damage.

Chronic Effects of Exposure: Chronic exposures by inhalation may produce erosion of the teeth and jaw necrosis.

Medical Conditions Aggravated by Exposure: N/D
Additional Information: N/D

----------TOXICITY DATA----------

LD50 Oral (mouse): 700 mg/kg
LD50 Dermal (rabbit): N/D
LC50 (species): N/D

Carcinogenicity: N/D
Sensitization: Skin sensitization may occur in persons previously exposed to formaldehyde.
Irritancy: N/D
Reproductive Effects: N/D
Teratogenicity: N/D
Mutagenicity: N/D
Toxicologically Synergistic Products: N/D
Other Data: N/D
Environmental Effects: N/D

----------PREVENTATIVE MEASURES----------

Ventilation (Engineering Controls): Ventilation may be used to control or reduce airborne concentrations.

Personal Protective Equipment
Respiratory: Use NIOSH or MSHA approved equipment when airborne exposure limits are exceeded. NIOSH/MSHA approved breathing equipment may be required for non-routine and emergency use.
Eye: Wear chemical safety goggles and face shield. Do not wear contact lenses when working with this substance.
Clothing: Wear gloves and protective clothing to prevent skin contact.

Other Protective Measures: Have eye washing facilities readily available where eye contact can occur. Provide safety showers at any location where skin contact can occur.

Action to Take for Spills or Leaks: If your facility or operation has an

Class: 8 (9.2)
PKG: II

WHMIS Classification: B.3; D.1B; E

Listed on the Domestic Substances List (DSL): Yes

----------FOR PRODUCT AND SALES INFORMATION----------

Contact Your Local Van Waters & Rogers Ltd. Branch Office.

----------NOTICE----------

VAN WATERS & ROGERS LTD. EXPRESSLY DISCLAIMS ALL EXPRESSED OR IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE PRODUCT PROVIDED.

----------REVISION INFORMATION----------

02/93: 3-year review. Reconstruction (P1242).

Legend: N/AP - Not Applicable. N/D - No Data Available.

========== END OF MSDS ==========

* *
* C H E M I N F O *
* Canadian Centre for Occupational Health and Safety *
* * * * * * * * * * * * Issue : 95-1 (February, 1995) *

*** SECTION 1. CHEMICAL IDENTIFICATION ***

CHEMINFO RECORD NUMBER : 466
CCOHS CHEMICAL NAME : Formic acid
SYNONYMS :
* Acide formique
* Formylic acid
* Hydrogen carboxylic acid
* Methanoic acid
* Aminic acid
CAS REGISTRY NUMBER : 64-18-6
UN/NA NUMBER(S) : 1779
RTECS NUMBER(S) : LQ4900000
CHEMICAL FAMILY : Carboxylic acid / alkanoic acid
MOLECULAR FORMULA : C-H2-O2
STRUCTURAL FORMULA : H-CO-OH

STATUS :
This CHEMINFO record is complete and provides a detailed evaluation of health, fire and reactivity hazards, as well as recommendations on topics such as handling and storage, personal protective equipment, accidental release and first aid.

*** SECTION 2. DESCRIPTION ***

APPEARANCE AND ODOUR :
Colourless liquid that may fume, with a pungent, penetrating odour; lachrymator (vapour irritates the eyes and causes tears).
ODOUR THRESHOLD :
20-40 mg/m3 (detection) (12)
WARNING PROPERTIES :
POOR: Odour threshold is above the TLV
COMPOSITION/PURITY :
Commercially available as concentrated solutions in water (85-90% acid) and in purer grades (98% or greater). The major impurity is acetic acid (up to 0.8%). Water stabilizes the acid.(1)
USES AND OCCURRENCES :
Used as a food preservative; fumigant; intermediate in the production of formates; in textile dyeing and finishing; in leather tanning; in the manufacture of pharmaceuticals, rubbers and plastics.(1,2)

*** SECTION 3. HAZARDS IDENTIFICATION ***

** POTENTIAL HEALTH EFFECTS **

EFFECTS OF SHORT-TERM (ACUTE) EXPOSURE :
INHALATION :
Mist or vapour (for example, 15 ppm) can cause severe irritation of nose and throat, nasal discharge, coughing and difficulty breathing.(8,10) Severe exposures might produce a dangerous accumulation of fluid in the lungs (pulmonary edema), shock and death due to respiratory failure. Symptoms of

pulmonary edema, such as shortness of breath, may not appear until a few hours after exposure.

SKIN CONTACT :
Liquid can rapidly cause piercing pain, reddening, and burns of the skin. Formic acid can be readily absorbed through the skin, producing severe toxic effects. In one accident hot formic acid was splashed on a worker's face and neck and resulted in immediate skin reddening, difficult breathing, difficult swallowing, inability to speak and death 6 hours later.(5)

EYE CONTACT :
Vapour can cause eye irritation. Mists or spray of pure acid or dilute solutions can cause severe damage to eye tissues. Accidents involving eye contact with concentrated formic acid solutions (80%) have produced corrosive injury, including irreversible damage to the cornea in a few cases.(7,8)

INGESTION :
Ingestion of concentrated solutions of formic acid can produce severe burns to the lips, mouth and throat. Other symptoms of poisoning include: salivation, burning sensation in mouth and throat, bloody diarrhea, agonizing pain. In the severest cases symptoms can include shock, rapid and soft pulse, cold and clammy skin, a drop in blood pressure, severe respiratory effects, kidney damage and death.(5,11) The estimated lethal dose to humans is 30 mL of formic acid.(16)

EFFECTS OF LONG-TERM (CHRONIC) EXPOSURE :
Ingestion of 0.5 gm of formic acid (diluted with water) daily for 4 weeks produced no toxic effects. Ingestion of 2 to 3 grams of formate (salt of formic acid) several times daily produced dizziness, nausea, vomiting, difficult breathing, blood in the urine, and a lower body temperature.(5) SENSITIZATION: There is one report of an asthmatic farmer who suffered typical asthma-like reaction when inhaling formic acid.(8) No specific allergy to formic acid has been described. This suggests that formic acid is not a cause of sensitization.(8)

CARCINOGENICITY :
No information available

TERATOGENICITY AND EMBRYOTOXICITY :
No human information available. No effects reported in a 3-generation animal study at one low dose.

REPRODUCTIVE TOXICITY :
No human information available. No effects reported in a 3-generation study at one low dose.

MUTAGENICITY :
No human or mammalian information available. Formic acid was reported mutagenic in a number of short-term tests.(3)

TOXICOLOGICALLY SYNERGISTIC MATERIALS :
No information available

POTENTIAL FOR ACCUMULATION :
Does not accumulate. Small amounts of formic acid are broken down and eliminated very quickly as carbon dioxide in the breath. Larger doses may be excreted unchanged in the urine.(5)

*** SECTION 4. FIRST AID MEASURES ***

INHALATION :
Take proper precautions to ensure your own safety before attempting rescue; e.g., wear appropriate protective equipment, use the "buddy" system. Remove source of contamination or move victim to fresh air. If breathing is difficult, oxygen may be beneficial if administered by a person trained in its use, preferably on a physician's advice. Obtain medical advice immediately.

SKIN CONTACT :
Avoid direct contact with this chemical. Wear impervious protective gloves, if necessary.
As quickly as possible, flush contaminated area with lukewarm, gently running water for at least 20 minutes, by the clock.
Under running water, remove contaminated clothing, shoes, and leather goods (e.g., watchbands, belts). If irritation persists, repeat flushing.
Obtain medical advice immediately.
Completely decontaminate clothing, shoes and leather goods before re-use or discard.
EYE CONTACT :
Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for 60 minutes, by the clock, holding the eyelid(s) open. Take care not to rinse contaminated water into the non-affected eye. If irritation persists, repeat flushing.
Obtain medical attention immediately.
INGESTION :
Never give anything by mouth if victim is rapidly losing consciousness, or is unconscious or convulsing.
Have victim rinse mouth thoroughly with water.
DO NOT INDUCE VOMITING. Have victim drink 240 to 300 mL (8 to 10 oz.) of water.
If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration. Repeat administration of water.
If breathing has stopped, trained personnel should begin artificial respiration or, if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately (avoid mouth-to-mouth contact).
Obtain medical attention immediately.
Quickly transport victim to an emergency facility.
FIRST AID COMMENTS :
Provide general supportive measures (comfort, warmth, rest). Consult a physician and/or the nearest Poison Control Centre for all exposures except minor instances of inhalation or skin contact. Some recommendations in the above sections may be considered medical acts in some jurisdictions. These recommendations should be reviewed with a physician and appropriate delegation of authority obtained, as required. All first aid procedures should be periodically reviewed by a physician familiar with the material and its conditions of use in the workplace.

*** SECTION 5. FIRE FIGHTING MEASURES ***

FLASH POINT :
69 deg C (156 deg F); 50 deg C (122 deg F) (90% solution) (14)
LOWER FLAMMABLE (EXPLOSIVE) LIMIT (LFL/LEL) :
18% (90% solution) (14)
UPPER FLAMMABLE (EXPLOSIVE) LIMIT (UFL/UEL) :
57% (90% solution) (14)
AUTOIGNITION (IGNITION) TEMPERATURE :
539 deg C (1004 deg F); 434 deg C (813 deg F) (90% solution)
EXPLOSION DATA - SENSITIVITY TO MECHANICAL IMPACT :
Probably not sensitive. Moderately stable material.
EXPLOSION DATA - SENSITIVITY TO STATIC CHARGE :
No information available
COMBUSTION AND THERMAL DECOMPOSITION PRODUCTS :
Carbon monoxide and water are produced at temperatures up to 150 deg C. At higher temperatures carbon dioxide and hydrogen gas are produced.
Formaldehyde is produced at 300-400 deg C.(15)
FIRE HAZARD COMMENTS :

Vapour may accumulate in low lying areas, such as tanks and hopper cars.

EXTINGUISHING MEDIA :

Water spray, dry chemical, alcohol foam or carbon dioxide (14)

FIRE FIGHTING INSTRUCTIONS :

Use water to keep fire exposed containers cool. If a leak or spill has not ignited, use water spray to disperse the vapours and to protect personnel attempting to stop a leak.(14) Water spray may be used to dilute spills to nonflammable mixtures, to flush spills away and avoid exposures.(14)

** NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) HAZARD INDEX **

NFPA - HEALTH	: 3 - Short exposure could cause serious temporary or residual injury.
NFPA - FLAMMABILITY	: 2 - Must be moderately heated or exposed to relatively high temperatures before ignition can occur.
NFPA - REACTIVITY	: 0 - Normally stable under fire conditions, and not reactive with water.

*** SECTION 6. ACCIDENTAL RELEASE MEASURES ***

PRECAUTIONS :

Restrict access to area until completion of clean-up. Ensure clean-up is conducted by trained personnel only. Wear adequate personal protective equipment. Ventilate area. Extinguish or remove all ignition sources. Notify government occupational health and safety and environmental authorities.

CLEAN-UP :

Do not touch spilled material. Prevent material from entering sewers or confined spaces. Stop or reduce leak if safe to do so. Small spills: Soak up spill with absorbent material which does not react with spilled chemical. Put material in suitable, covered, labelled containers. Flush area with water. Contaminated absorbent material may pose the same hazards as the spilled product. Large spills: Contact fire and emergency services and supplier for advice. CAUTION: Mixing formic acid and water may generate heat and fumes.

*** SECTION 7. HANDLING AND STORAGE ***

HANDLING :

Keep material away from sparks, flames and other ignition sources. Post "NO SMOKING" signs in area of use.

Avoid release of vapours or mists into workplace air.

Use extreme caution. Do not attempt to open container if it is of unknown age. Carbon monoxide vapours may be present in formic acid containers, empty or full. A build-up of gas pressure in an unvented container may cause an explosion or eruption.

Use smallest possible amounts in designated areas with adequate ventilation. Have emergency equipment (for fires, spills, leaks, etc.) readily available.

Label containers. Keep containers closed when not in use. Empty containers may contain residues which are hazardous.

Large storage containers may pose a hazard to entry; atmospheres should be checked for formic acid, carbon monoxide and oxygen levels.

STORAGE :

Store in a cool, dry, well-ventilated area, out of direct sunlight. Store the acid at a temperature above its melting point (8 deg C) since freezing and expansion of the acid could cause containers to burst. Store away from heat and ignition sources. Store away from incompatible materials such as

oxidizing materials, strong acids, or strong bases.
Use grounded, non-sparking ventilation systems and electrical equipment that does not provide a source of ignition.
Use corrosion-resistant structural materials and lighting and ventilation systems in the storage area.
Store in suitable, labelled containers, equipped with vented closures (eg. approved safety cans). Protect from damage. Sealed containers may require periodic venting to prevent bursting.
Use suitable, approved storage cabinets, tanks, rooms and buildings.
Limit quantity of material in storage. Restrict access to storage area.
Post warning signs when appropriate. Keep storage area separate from populated work areas. Inspect periodically for deficiencies such as damage or leaks.
Comply with all applicable regulations for the storage and handling of combustible materials.

*** SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION ***

NOTE : Exposure to this material can be controlled in many ways. The measures appropriate for a particular worksite depend on how this material is used and on the extent of exposure. This general information can be used to help develop specific control measures. Ensure that control systems are properly designed and maintained. Comply with occupational, environmental, fire, and other applicable regulations.

AMPLING AND ANALYSIS :
Use appropriate instrumentation and sampling strategy (location, timing, duration, frequency, and number of samples). Interpretation of the sampling results is related to these variables and the analytical method.
COLORIMETRIC-INDICATING (DETECTOR) TUBES: Commercially available.
NIOSH METHOD(S): 232 - NIOSH Manual of Analytical Methods. 2nd ed. Vol. 1; S173 - NIOSH Manual of Analytical Methods. 2nd ed. Vol. 5
Two OSHA methods, ID 112 and IMIS1310 are reported for formic acid.

NGINEERING CONTROLS :
Engineering control methods to reduce hazardous exposures are preferred. Methods include mechanical ventilation (dilution and local exhaust), process or personnel enclosure, control of process conditions, and process modification (e.g., substitution of a less hazardous material). Administrative controls and personal protective equipment may also be required. Use a non-sparking, grounded, corrosion-resistant ventilation system separate from other exhaust ventilation systems. Exhaust directly to the outside. Use local exhaust ventilation, and process enclosure if necessary, to control airborne mist and vapour. Supply sufficient replacement air to make up for air removed by exhaust system.

ERSONAL PROTECTIVE EQUIPMENT :
If engineering controls and work practices are not effective in controlling exposure to this material, then wear suitable personal protective equipment including approved respiratory protection. Have appropriate equipment available for use in emergencies such as spills or fire. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection. Refer to the CSA Standard Z94.4-93, "Selection, Care, and Use of Respirators," available from the Canadian Standards Association, Rexdale, Ontario, M9W 1R3.

ESPIRATORY PROTECTION GUIDELINES :
NIOSH RECOMMENDATIONS FOR FORMIC ACID CONCENTRATIONS IN AIR (17):

UP TO 30 ppm: SAR; or SCBA
EMERGENCY OR PLANNED ENTRY INTO UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.
ESCAPE: Gas mask with organic vapour canister and high-efficiency particulate filter; or escape-type SCBA.
NOTE: The IDLH concentration for formic acid is 30 ppm.
NOTE: Substance reported to cause eye irritation or damage; may require eye protection.
ABBREVIATIONS: SAR = supplied-air respirator; SCBA = self-contained breathing apparatus. IDLH = Immediately Dangerous to Life or Health.
NOTE: In these recommendations, the IDLH concentration is defined as the maximum concentration which would not cause any escape-impairing symptoms or irreversible health effects to a person exposed for 30 minutes if the respirator failed.
Recommendations apply only to NIOSH and MSHA (Mine Safety and Health Administration) approved respirators.

EYE/FACE PROTECTION :
Chemical safety goggles. A face shield may also be necessary.

SKIN PROTECTION :
Impervious gloves, coveralls, boots, and/or other resistant protective clothing. Have a safety shower/eye-wash fountain readily available in the immediate work area.

RESISTANCE OF MATERIALS FOR PROTECTIVE CLOTHING :
GOOD: Polyurethane, butyl, nitrile or natural rubber, PVC, neoprene, nitrile+PVC, neoprene+natural rubber, neoprene+styrene-butadiene rubber.(13)
FAIR/POOR: Polyethylene or Viton.(13) NOTE: Resistance of specific materials can vary from product to product. Evaluate resistance under conditions of use and maintain clothing carefully.

EXPOSURE CONTROLS/PERSONAL PROTECTION COMMENTS :
Remove contaminated clothing promptly. Keep contaminated clothing in closed containers. Discard or launder before rewearing. Inform laundry personnel of contaminant's hazards. Do not smoke, eat or drink in work areas. Wash hands thoroughly after handling this material. Maintain good housekeeping.

** EXPOSURE GUIDELINES **

* THRESHOLD LIMIT VALUES (TLVs) / AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH) / 1994-95 *

TIME-WEIGHTED AVERAGE (TLV-TWA) : 5 ppm (9.4 mg/m3)
SHORT-TERM EXPOSURE LIMIT (TLV-STEL) :
10 ppm (19 mg/m3)
TLV COMMENTS :
NOTE: In many Canadian jurisdictions, exposure limits are similar to the ACGIH TLVs. Since the manner in which exposure limits are established, interpreted, and implemented can vary, obtain detailed information from the appropriate government agency in each jurisdiction.

* PERMISSIBLE EXPOSURE LIMITS (PELs) / FINAL RULE LIMITS / OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) *

TIME WEIGHTED AVERAGE (PEL-TWA) : 5 ppm (9 mg/m3)

NOTE: The OSHA PEL Final Rule Limits are currently non-enforceable due to a court decision. The OSHA

PEL Transitional Limits are now in force.

* PERMISSIBLE EXPOSURE LIMITS (PELs)
TRANSITIONAL LIMITS / OCCUPATIONAL
SAFETY AND HEALTH ADMINISTRATION (OSHA) *

TIME WEIGHTED AVERAGE (PEL-TWA) : 5 ppm (9 mg/m3)

*** SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES ***

MOLECULAR WEIGHT : 46.03
CONVERSION FACTOR :
1 ppm = 1.88 mg/m3; 1 mg/m3 = 0.53 ppm at 25 deg C
MELTING POINT : 8.4 deg C (47.1 deg F)
BOILING POINT : 100.5 deg C (212.9 deg F)
RELATIVE DENSITY (SPECIFIC GRAVITY) :
1.220 at 20 deg C (water = 1)
SOLUBILITY IN WATER :
Freely soluble in water
SOLUBILITY IN OTHER LIQUIDS :
Soluble in acetone, alcohol, benzene, ether, glycerol, and toluene.(4)
VAPOUR DENSITY : 1.6 (air = 1)
VAPOUR PRESSURE : 35 mm Hg (4.67 kPa) at 20 deg C
SATURATION VAPOUR CONCENTRATION : 46000 ppm at 20 deg C (calc.)
EVAPORATION RATE : Not available
pH VALUE : 2.38 (0.1M solution) (calc.)
CRITICAL TEMPERATURE : Not available
COEFFICIENT OF OIL/WATER DISTRIBUTION (PARTITION COEFFICIENT) :
log P(oct) = -1.55; -0.22 (calc.) (12)
OTHER PHYSICAL PROPERTIES :
VISCOSITY: 1.804 centipoise (0.0018 Pa.S) at 20 deg C (4) ACIDITY:
Moderately strong acid. pKa = 3.76

*** SECTION 10. STABILITY AND REACTIVITY ***

STABILITY :
Moderately stable. May decompose slowly during storage to produce carbon monoxide gas.(1,15)
HAZARDOUS POLYMERIZATION :
Does not occur
HAZARDOUS DECOMPOSITION PRODUCTS :
Carbon monoxide
INCOMPATIBILITY - MATERIALS TO AVOID :
ALUMINUM - May react, causing incandescence.
OXIDIZING AGENTS - May explode violently.
STRONG ACIDS (eg. sulfuric, nitric acids) - React violently, producing heat and gas.
FURFURYL ALCOHOL - May react violently and explosively.
NITROMETHANE - Mixture may react explosively if shocked.
CATALYSTS (eg. Palladium-carbon, Nickel) - May cause decomposition of formic acid, producing flammable and explosive hydrogen gas.
STRONG BASES - May react violently.
CORROSIVITY TO METALS :
Corrosive to lead, aluminum, cast iron, and cast steel. Does not corrode stainless steel, and certain alloys of steel.
STABILITY AND REACTIVITY COMMENTS :
Formic acid can break down during storage to produce toxic, flammable carbon monoxide gas. 98-99% formic acid has a high potential for breakdown to

carbon monoxide when stored for 6 months or more at 25 to 30 deg C. Full, unvented containers of pure acid may burst from accumulated pressure.(1,15)

*** SECTION 11. TOXICOLOGICAL INFORMATION ***

LC50 (rat): 15 g/m3 (15-minute exposure) (3)*
LC50 (mouse): 6.2 g/m3 (15-minute exposure) (3)*
* Reported but details cannot be confirmed.
LD50 (oral, rat): 1100 mg/kg (3)
LD50 (oral, mouse): 700 mg/kg (3)
Lethal dose (oral, dog): 4000 mg/kg (5)
Lethal dose (oral, rabbit): Greater than 4000 mg/kg (5)
Lethal doses caused depressed activity, vomiting, convulsions and difficult breathing.(3,5)
INHALATION (guinea pig): Inhalation of 42.5 ppm for 1 hour produced rapid, shallow, laboured breathing.(6)
EYE IRRITATION (rabbit): Application of either a 10% solution for five minutes (volume unspecified) or 122 mg of formic acid produced corrosive effects.(7)
SKIN IRRITATION (rabbit): 610 mg of formic acid produced mild irritation in a standard Draize test (open, 24 hours).(3)
LONG-TERM INHALATION: Young male rats exposed to 20 ppm formic acid vapour for 3 weeks (6 hours/day, 5 days/week) showed changes in four enzyme levels in the brain and liver.(4) Another source suggests kidney effects were also seen in this study.(8)
LONG-TERM SKIN EFFECTS: Daily application of 8% formic acid in water onto mouse ears for 50 days, produced no skin effects.(2)
LONG-TERM INGESTION: Rats ingesting 8 to 360 mg/kg formic acid in drinking water for 2 to 27 weeks showed reduced body weight gain at the highest dose level.(2) Young rats ingesting 0.5 to 1% formic acid in drinking water for 6 weeks showed reduced body weight gain and reduced organ weights.(2)
REPRODUCTIVE STUDIES: No adverse effects were seen in male and female rats ingesting 0.2% calcium formate (salt of formic acid) in their diet through 3 successive generations.(2)
MUTAGENICITY: Formic acid has produced mutations in E.coli bacteria, some non-mammalian cells, and in the germ cells of insects (Drosophila).(3)

*** SECTION 12. ECOLOGICAL INFORMATION ***

NOTE : This section is under development.

*** SECTION 13. DISPOSAL CONSIDERATIONS ***

Review federal, provincial and local government requirements prior to disposal. Store material for disposal as indicated in Storage Conditions. Disposal by controlled incineration or secure landfill may be acceptable.

*** SECTION 14. TRANSPORT INFORMATION ***

** TRANSPORTATION OF DANGEROUS GOODS (TDG) SHIPPING INFORMATION **

SHIPPING NAME AND DESCRIPTION: Formic acid
PRODUCT IDENTIFICATION NUMBER (PIN): 1779
CLASSIFICATION: 8 - Corrosive substance; 9.2 - Substance hazardous to the environment
SPECIAL PROVISIONS: 109
PACKING GROUP: II
REGULATED LIMIT: ---

NOTE: This information incorporates Schedule No. 18 amendments to the Transportation of Dangerous Goods Act, 1992, effective October 1, 1994.

*** SECTION 15. REGULATORY INFORMATION ***

** WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS) **

PROPOSED WHMIS CLASSIFICATION :
B3 - Flammable and combustible material - Combustible liquid
E - Corrosive material

WHMIS HEALTH EFFECTS :
Corrosive to skin
TDG class 8 - corrosive substance

WHMIS INGREDIENT DISCLOSURE LIST :
Included for disclosure at 1% or greater

DETAILED WHMIS CLASSIFICATION ACCORDING TO CRITERIA :
CLASS A - COMPRESSED GAS: Does not meet criteria
CLASS B - FLAMMABLE & COMBUSTIBLE MATERIAL: Meets criteria for "Combustible liquid"; 90% formic acid solution has a flash point of 50 deg C (122 deg F).
CLASS C - OXIDIZING MATERIAL: Does not meet criteria
CLASS D - POISONOUS AND INFECTIOUS MATERIAL. DIVISION 1 - IMMEDIATE AND SERIOUS TOXIC EFFECTS: Insufficient information
Acute Lethality: Insufficient information. LC50 values reported but cannot be confirmed.
CLASS D - POISONOUS AND INFECTIOUS MATERIAL. DIVISION 2 - OTHER TOXIC EFFECTS: Insufficient information for classification. See detailed evaluation below.
Chronic Toxic Effects: Insufficient information
Carcinogenicity: Insufficient information
Teratogenicity and Embryotoxicity: Insufficient information
Reproductive Toxicity: Insufficient information. No effects reported in a 3-generation rat study at one low dose.
Mutagenicity: Insufficient information. No in vivo mammalian studies.
Respiratory Tract Sensitization: Does not meet criteria; not reported as human respiratory sensitizer.
Skin Irritation: Does not meet criteria; corrosive materials are not also classified as irritants.
Eye Irritation: Does not meet criteria; corrosive materials are not also classified as irritants.
Skin Sensitization: Insufficient information; no reports.
CLASS E - CORROSIVE MATERIAL: Meets criteria; corrosive to steel - aluminum - animal skin; TDG class 8
CLASS F - DANGEROUSLY REACTIVE MATERIAL: Does not meet criteria

OSHA HAZARD COMMUNICATION EVALUATION :
Meets criteria for hazardous material, as defined by 29 CFR 1910.1200.

*** SECTION 16. OTHER INFORMATION ***

SELECTED BIBLIOGRAPHY :
(1) Kirk-Othmer encyclopedia of chemical technology. Vol. 11. 3rd ed. John Wiley & Sons, 1980. p. 251-257
(2) Patty's industrial hygiene and toxicology. 3rd rev. ed. Vol. 2C. John Wiley & Sons, 1982. p. 4903-4909

(3) RTECS record for formic acid. Last updated 8703; printed 1988-03-11
(4) HSDB record for formic acid. Complete update 10/14/86; printed 1988-03-11
(5) von Oettingen, W.F. The aliphatic acids and their esters--toxicity and potential dangers. A.M.A. Archives of Industrial Health. Vol. 20 (Dec. 1959). p. 81-95
(6) Amdur, M.O. The response of guinea pigs to inhalation of formaldehyde and formic acid alone and with a sodium chloride aerosol. Int. J. Air. Poll. Vol. 3, no. 4 (1960). p. 201-220
(7) Grant, W.M. Toxicology of the eye. 3rd ed. Charles C. Thomas, 1986. p. 446-448
(8) Liesivuori, J., et al. Short communication : farmers' exposure to formic acid vapour in silage making. Ann. Occup. Hyg. Vol. 27, no. 3 (1983). p. 327-329
(9) Solmann, T. Studies of chronic intoxications on albino rats : III. Acetic and formic acids. Journal of Pharmacology and Experimental Therapeutics. Vol. 16 (1921). p. 463-474
(10) Documentation of the threshold limit values and biological exposure indices. 5th ed. ACGIH, 1986. p. 279
(11) v. Muhlendahl, K.E., et al. Local injuries by accidental ingestion of corrosive substances by children. Archives of Toxicology. Vol. 39 (1978). p. 299-314
(12) Verschueren, K. Handbook of environmental data on organic chemicals. 2nd ed. Van Nostrand Reinhold, 1983. p. 683-685
(13) Schwope, A.D., et al. Guidelines for the selection of chemical protective clothing. 3rd ed. Vol. 1. ACGIH, 1987. p. 67
(14) Fire protection guide on hazardous materials. 9th ed. National Fire Protection Association, 1986. p. 49-51, 325M-54, 491M-97
(15) Acide formique (fiche toxicologique no. 149). I.N.R.S. Cahiers de Notes Documentaires. No. 98, 1er trimestre (1980). p. 177-180
(16) Dreisbach, R.H. Handbook of poisoning : prevention, diagnosis & treatment. 11th ed. Lange Medical Publications, 1983. p. 218-219
(17) NIOSH pocket guide to chemical hazards. NIOSH, June 1990. p. 118-119

Information on chemicals reviewed in the CHEMINFO database is drawn from a number of publicly available sources. A list of general references used to compile CHEMINFO records is available in the database Help.

REVIEW/PREPARATION DATE :
1989-02-14
REVISION INDICATORS :
PEL-TWA; 1993-03
NFPA (health); 1993-03
NFPA (flammability); 1993-03
NFPA (reactivity); 1993-03
REGULATORY INFORMATION; 1994-03
Trans PEL-TWA; 1993-04
TDG; 1994-03

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* C H E M I N F O *
* Canadian Centre for Occupational Health and Safety *
* * * * * * * * * * * * Issue : 95-1 (February, 1995) *

*** SECTION 1. CHEMICAL IDENTIFICATION ***

CHEMINFO RECORD NUMBER : 76
CCOHS CHEMICAL NAME : Methylene chloride
SYNONYMS :
* Dichloromethane
* Methylene dichloride
* Clorure de méthylène
CAS REGISTRY NUMBER : 75-09-2
UN (UN/NA NUMBER(S)) : 1593
RTECS NUMBER(S) : PA8050000
CHEMICAL FAMILY : Halogenated aliphatic hydrocarbon / haloalkane / dihaloalkane
MOLECULAR FORMULA : C-H2-Cl2

STATUS :
This CHEMINFO record is complete and provides a detailed evaluation of health, fire and reactivity hazards, as well as recommendations on topics such as handling and storage, personal protective equipment, accidental release and first aid.

*** SECTION 2. DESCRIPTION ***

APPEARANCE AND ODOUR :
Colourless liquid with a penetrating ether-like odour.
ODOUR THRESHOLD :
A wide range of values are reported (1.2 to 440 ppm), but detection occurs around 150 ppm and recognition around 230 ppm.
WARNING PROPERTIES :
Poor/unreliable - odour threshold is above the TLV, olfactory fatigue may occur (smell may not be noticed after short exposures).
COMPOSITION/PURITY :
Commercially available in high purity (99-99.99%). May contain small amount of stabilizers such as cyclohexane, propylene oxide, alcohols, phenols and amines. Commercial dichloromethane may contain impurities such as methyl chloride, chloroform,1,1- dichloroethane and trans-1,2-dichloroethane.(1)
USES AND OCCURRENCES :
Solvent; degreasing agent; paint remover ingredient; aerosol products ingredient; blowing agent in foams; refrigerant.

*** SECTION 3. HAZARDS IDENTIFICATION ***

** EMERGENCY OVERVIEW **

Colourless liquid with a penetrating ether-like odour. Essentially non-flammable under most conditions of use, but can probably burn if strongly heated. Can decompose at high temperatures forming toxic gases, such as hydrogen chloride and phosgene. TOXIC. Mild central nervous system depressant. May cause headache, nausea, dizziness, drowsiness, incoordination and confusion, unconsciousness and death. Causes skin and eye irritation. SUSPECT CANCER HAZARD - may cause cancer.

** POTENTIAL HEALTH EFFECTS **

EFFECTS OF SHORT-TERM (ACUTE) EXPOSURE :

INHALATION :

Methylene chloride can cause slight irritation and mild central nervous system (CNS) depression. Slight irritation of the nose and throat were noted in one study after exposure to 500 ppm for 1 hour.(15) However, in another study, no irritation was noted following exposures to concentrations from 515 ppm (1 hour) to 986 ppm (2 hrs). No effects were seen when volunteers were exposed to 213 ppm for 60 minutes.(17) Mild CNS effects (headache, dizziness) were seen in volunteers exposed to concentrations as low as 200 ppm for 2-3 hours (24) or 986 ppm for 1 hour.(17) Other signs of mild CNS depression such as dizziness, nausea, inability to concentrate, and reduced coordination have been reported in numerous case reports, usually when methylene chloride was used in poorly ventilated areas.(2,3,5) In more severe cases, methylene chloride has caused serious CNS depression including unconsciousness and respiratory failure as well as pulmonary edema and death.(2,3,5) Metabolism of methylene chloride to carbon monoxide (which binds to red blood cells forming carboxyhemoglobin) may cause heart problems.(2,31) See CHEMINFO record 57 for details on the effects of carbon monoxide.

SKIN CONTACT :

The liquid is a moderate to severe irritant. If methylene chloride is sealed to the skin by gloves, shoes or tight clothing, serious irritation may result. In one case, a worker developed second and third degree burns after collapsing and laying unconscious for about 30 minutes in methylene chloride.(23) Absorption through the skin can occur, but it is not reported to be significant.(16)

EYE CONTACT :

A vapour concentration of 500 ppm caused mild irritation after one hour.(15) Liquid and concentrated vapours may cause moderate to severe irritation. Liquid may cause temporary corneal damage.

INGESTION :

Methylene chloride has relatively low toxicity if ingested, based on limited human information and animal studies. Ingestion of about 1-2 pints (about 500-1000 mL) of a paint remover containing methylene chloride caused severe burns and swelling in the throat of a man. The man became unconscious one and a half hours after ingesting the paint remover and hospitalization was required. He recovered but continued to have stomach problems 6 months after the event.(22)

EFFECTS OF LONG-TERM (CHRONIC) EXPOSURE :

A group of employees exposed to an average concentration of 475 ppm (8 hour TWA) for more than 10 years was compared to a similar non-exposed group. There was no difference in liver, cardiac or neurologic health when the two groups were compared.(30)

SKIN: Repeated or prolonged skin contact may result in dermatitis (redness and irritation).

NEUROLOGICAL: Long-term (months, years) exposure to methylene chloride has caused neurological effects. In one case, a worker developed memory loss, speech problems and balance problems after regular exposure for about three years to an estimated airborne concentration of 500-1000 ppm methylene chloride.(25) In another case, a worker developed delirium (auditory hallucinations), memory loss, blurred vision and confusion. The worker had worked with a solution containing 78% methylene chloride in a vat room for 12 hour periods over 4 years.(26) In both of these case reports, the authors attribute the effects to the metabolism of methylene chloride to carbon monoxide.

CARCINOGENICITY :
In three studies, there was no increase in cancer among workers with long-term exposure to dichloromethane.(1) IARC evaluation of the carcinogenicity of dichloromethane to humans: Inadequate evidence.(6) Overall IARC evaluation of carcinogenic risk: Group 2B (possibly carcinogenic to humans).(6) The US National Toxicology Program (NTP) identifies this chemical as one which may reasonably be anticipated to be a carcinogen.

TERATOGENICITY AND EMBRYOTOXICITY :
In animal studies, slight fetotoxicity was noted, but no embryotoxic or teratogenic effects were seen. The fetotoxicity was observed at doses which were maternally toxic. A study of women working in a pharmaceutical factory found an increased risk of spontaneous abortions associated with exposure to several chemicals including methylene chloride.(1) Another study of women working with glue found methylene chloride and in the fetal tissues. This observation indicates methylene chloride crosses the placental barrier.(5)

REPRODUCTIVE TOXICITY :
In a case study, eight men had histories of infertility and testicular or prostatic discomfort. These men all worked in a process where they had mixed skin and inhalation exposure to methylene chloride. The average airborne concentration was 68 ppm (range 3.3 to 154.4 ppm). Biological monitoring also indicated exposure to methylene chloride. Four of the eight men were tested for sperm count. In all four, there was a significant reduction in the motile sperm count.(29) These case reports suggest that methylene chloride may inhibit sperm production. However, the men were exposed to other chemicals at the same time, and additional research is required to confirm these findings. Testicular atrophy was seen in one animal study.(13) Methylene chloride has been detected in human breast milk.(5)

MUTAGENICITY :
No human information. Methylene chloride is mutagenic in short-term tests using bacteria, yeast and mammalian cells. Animal studies were negative.

TOXICOLOGICALLY SYNERGISTIC MATERIALS :
Because methylene chloride can be metabolized to carbon monoxide, other exposures to carbon monoxide (e.g. smoking, exhaust) should be monitored. Animal evidence indicates that exposure to ethanol may potentiate the effects of methylene chloride.(7)

POTENTIAL FOR ACCUMULATION :
Animal evidence suggest that methylene chloride is well absorbed through the lungs, intestine and skin. It is converted to carbon monoxide and carbon dioxide in the body. The carbon monoxide results in increased levels of blood carboxyhemoglobin. Methylene chloride does not appear to accumulate in the body and is rapidly excreted.(3,5)

HEALTH COMMENTS :
Refer to CHEMINFO record 57E for a review of the potential effects of carbon monoxide.

*** SECTION 4. FIRST AID MEASURES ***

INHALATION :
Take proper precautions to ensure your own safety before attempting rescue (e.g. wear appropriate protective equipment). Remove source of contamination or move victim to fresh air. If breathing has stopped, properly trained personnel should begin artificial respiration (AR) or, if heart has stopped, cardiopulmonary resuscitation (CPR) immediately. If breathing is difficult, oxygen may be beneficial if administered by trained personnel, preferably on a doctor's advice. Quickly transport victim to an emergency care facility.

SKIN CONTACT :
As quickly as possible, flush with lukewarm, gently flowing water for at

least 20 minutes or until the chemical is removed. Under running water, remove contaminated clothing, shoes and leather goods (e.g. watchbands, belts). Obtain medical attention immediately. Completely decontaminate clothing, shoes and leather goods before re-use or discard.

EYE CONTACT :
Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for 20 minutes or until the chemical is removed, while holding the eyelid(s) open. Take care not to rinse contaminated water into the unaffected eye or onto the face. Obtain medical attention immediately.

INGESTION :
Never give anything by mouth if victim is rapidly losing consciousness, is unconscious or convulsing. DO NOT INDUCE VOMITING. Have victim drink about 250 ml (8 oz.) of water to dilute material in stomach. If vomiting occurs naturally, repeat administration of water. If breathing has stopped, trained personnel should begin artificial respiration (AR) or, if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately. Quickly transport victim to an emergency facility.

FIRST AID COMMENTS :
Provide general supportive measures (comfort, warmth, rest). Consult a doctor and/or the nearest Poison Control Centre for all exposures except minor instances of inhalation or skin contact. All first aid procedures should be periodically reviewed by a doctor familiar with the material and its condition of use in the workplace.

*** SECTION 5. FIRE FIGHTING MEASURES ***

FLASH POINT :
None measurable by standard methods. Vapour can burn in air above 100 deg C.(19)

LOWER FLAMMABLE (EXPLOSIVE) LIMIT (LFL/LEL) :
12% (oxygen-enriched air, elevated temperature, elevated pressure, or ambient air if ignition energy is high enough).(20)

UPPER FLAMMABLE (EXPLOSIVE) LIMIT (UFL/UEL) :
19% (oxygen-enriched air, elevated temperature, elevated pressure, or ambient air if ignition energy is high enough).(20)

AUTOIGNITION (IGNITION) TEMPERATURE :
556 deg C (1033 deg F) (19); 640 deg C (1184 deg F) (21)

EXPLOSION DATA - SENSITIVITY TO MECHANICAL IMPACT :
Stable material

EXPLOSION DATA - SENSITIVITY TO STATIC CHARGE :
Probably not sensitive under normally conditions.

COMBUSTION AND THERMAL DECOMPOSITION PRODUCTS :
Initial thermodegradation in dry air is at 120 deg C (248 deg F). Hydrogen chloride, carbon monoxide, carbon dioxide and small amounts of phosgene are produced. As moisture content increases the thermal degradation temperature decreases.(5,21)

FIRE HAZARD COMMENTS :
Methylene chloride is essentially non-flammable under most conditions of use. However it can probably burn if strongly heated. During a fire, irritating/toxic hydrogen chloride and phosgene gases may be generated. Methylene chloride can accumulate in confined spaces, resulting in an explosion hazard.

EXTINGUISHING MEDIA :
Use extinguishing agent suitable for surrounding fire.

FIRE FIGHTING INSTRUCTIONS :
Evacuate area and fight fire from a safe distance or a protected location. Approach fire from upwind to avoid hazardous vapours and toxic decomposition products. If products other than methylene chloride are burning, extinguish

fire using extinguishing agent suitable for surrounding fire. Isolate materials not yet involved in fire and protect personnel. Move containers from fire area if it can be done without risk. Use flooding quantities of water as a fog. Use water spray to keep fire-exposed containers cool and flush spills away and prevent exposures. Methylene chloride is hazardous to health. Fire fighters may enter the area only if they are protected from all contact with the material. A self-contained breathing apparatus (SCBA), pressure-demand (MSHA/NIOSH approved or equivalent) and full-protective clothing (Bunker Gear) should be worn.

** NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) HAZARD INDEX **

NFPA - HEALTH	: 2 - Intense or continued (but not chronic) exposure could cause temporary incapacitation or possible residual injury.
NFPA - FLAMMABILITY	: 1 - Must be preheated before ignition can occur.
NFPA - REACTIVITY	: 0 - Normally stable under fire conditions, and not reactive with water.

*** SECTION 6. ACCIDENTAL RELEASE MEASURES ***

PRECAUTIONS :

Restrict access to area until completion of clean-up. Ensure clean-up is conducted by trained personnel only. Provide adequate personal protective equipment. Ventilate area. Extinguish or remove all ignition sources. Notify government occupational and environmental authorities.

CLEAN-UP :

Do not touch spilled material. Prevent material from entering sewers or confined spaces. Vapours can collect in pits, low areas or other poorly ventilated areas. Stop or reduce leak if safe to do so. Small spills: Contain and soak up spill with earth, sand, or absorbent material which does not react with spilled material. Place material in suitable, covered, labelled containers. (See Storage Conditions). Flush area with water. Contaminated absorbent material may pose the same hazards as the spilled product. Large spills: Contact fire and emergency services and supplier for advice.

*** SECTION 7. HANDLING AND STORAGE ***

HANDLING :

This material is VERY TOXIC (SUSPECTED CANCER HAZARD). Before handling, it is extremely important that engineering controls are operating and that protective equipment requirements and personal hygiene measures are being followed.

Only authorized personnel should have access to this material. They should be properly trained regarding its hazards and its safe use. Maintenance and emergency personnel should be advised of potential hazards.

If methylene chloride is released, immediately put on a suitable respirator and leave the area until the severity of the release is determined. Attach appropriate warning signs to storage area and to containment devices.

Closed handling systems for processes involving this material are recommended. Immediately report leaks, spills or ventilation failures. Be aware of typical signs and symptoms of poisoning and first aid procedures. Any signs of illness should be reported immediately to supervisory personnel. Do not use with incompatible materials such as strong oxidizers, caustics, aluminum powder, amines, azide forms of quaternary ion exchange resins, dimethyl sulfoxide and perchloric acid, reactive materials

(e.g. lithium, sodium, potassium), nitric acid, N-methyl-nitrosourea and potassium tert-butoxide. All these may lead to exothermic reaction and/or explosion. Do not use near welding operations, flames or hot surfaces because of the risk of formation of toxic hydrogen chloride or phosgene. Do not perform any welding, cutting, soldering, drilling or other hot work on an empty vessel, container or piping until all liquid and vapours have been cleared.

Avoid generating mists. Prevent the release of vapours/mists into workplace air. Use in smallest possible amounts in appropriate, labelled containment devices (fume hood, glove box, biological safety cabinets, isolation cabinets). Containment devices should be made of smooth, unbreakable, compatible material. Maintain containment devices at appropriate air flow and negative pressure. Check regularly. Use in clearly labelled, designated areas. Control access to designated area. Inspect containers for leaks before handling. Cautiously, transfer material from storage to work area in a sealed, unbreakable container (primary container) and place primary container inside sealed, unbreakable outer container (secondary container). Place sufficient packing between primary and secondary containers to minimize disturbing the material. Prevent damage to containers. Label containers. Open containers carefully on a stable surface. Keep containers closed when not in use. Assume that empty containers contain residues which are hazardous. Keep a record of acquisition date, opening date and quantity used. Cover work surfaces with compatible, impervious and/or disposable material for easier containment and clean-up of spills.

Never return contaminated material to its original container. Good housekeeping is very important. Keeping work areas clean is essential. Use work surfaces that can be easily decontaminated. Do not contaminate air or water systems with this material when used in conjunction with vacuum devices. Protect vacuum lines. Use separate vacuum pump inside or vented into appropriate chemical fume hood. If possible, air flow should move from area of lower contamination potential to area of higher contamination potential.

Follow handling precautions on Material Safety Data Sheet and those established by the laboratory. Have suitable emergency equipment for fires, spills and leaks readily available. Maintain handling equipment. Comply with applicable regulations.

TORAGE :

Store in a cool, dry, well-ventilated area, out of direct sunlight and away from heat and ignition sources. Keep quantities stored as small as possible. Store away from incompatible materials, such as aluminum powder, amines, nitric acid, lithium, sodium, potassium tert-butoxide which increase the risk of fire and explosion.

Storage area should be clearly identified, clear of obstruction and accessible only to trained and authorized personnel. Keep storage area separate from work areas, eating areas and protective equipment storage. Post warning signs. Inspect periodically for damage or leaks. Have appropriate fire extinguishers and spill clean-up equipment in storage area. Inform the local fire department of storage quantities and location. Inspect all incoming containers/cylinders to make sure they are properly labelled and not damaged. Store in suitable, unbreakable, labelled containers. Store containers at a convenient height for handling, below eye level if possible. Keep containers tightly closed when not in use and when empty. Protect from damage. Containers should be equipped with either external water cooling or with internal cooling units installed in their pressure release system.

Consider leak detection and alarm equipment for storage area. Contain spills or leaks by storing in trays made from compatible materials. Keep

absorbents for leaks and spills readily available. Provide raised sills or ramps at doorways or create a trench which drains to a safe location. Floors should be sealed to prevent absorption. Keep empty containers in separate storage area. Empty containers may contain hazardous residues. Keep closed.
Avoid bulk storage indoors. Store in isolated fireproof building, if possible. Storage tanks should be above ground, over an area sealed on the bottom and diked to hold entire contents.
Follow any special instructions for storage on Material Safety Data Sheet (e.g. maximum storage quantities).

*** SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION ***

NOTE : Exposure to this material can be controlled in many ways. The measures appropriate for a particular worksite depend on how this material is used and on the extent of exposure. This general information can be used to help develop specific control measures. Ensure that control systems are properly designed and maintained. Comply with occupational, environmental, fire, and other applicable regulations.

SAMPLING AND ANALYSIS :
Sampling should only be done by trained personnel using appropriate instrumentation and sampling strategy (location, timing, duration, frequency and number of samples). Interpretation of the sampling results is related to these variables and the analytical methods.
OSHA METHOD 59 - OSHA Analytical Methods Manual. 2nd ed. Part 1. Vol. 3. Collection on coconut shell based activated charcoal sorbent tube. Desorption with carbon disulphide (CS2). Analysis by gas chromatography using flame ionization detector (FID). Detection limit: 29 ppb.
OSHA METHOD 80 - OSHA Manual of Analytical Methods. 2nd ed. Part 1. Vol. 3. Collection on a carbosieve S-III glass tube. Desorption with carbon disulphide (CS2)/dimethyl formamide (99:1) mixture in the presence of anhydrous sodium sulfate. Analysis by gas chromatography using flame ionization detector (FID). Detection limit: 2.09 ug.
NIOSH METHOD 1005 - NIOSH Manual of Analytical Methods. 3rd ed. Vol. 2. Collection on 2 coconut shell based activated charcoal sorbent tubes (placed in series). Desorption with carbon disulphide (CS2). Analysis by gas chromatography using flame ionization detector (FID). Detection limit: 0.01 mg (estimated).
Other methods for sampling/analysis of airborne methylene chloride are reviewed in references 1 and 5.
DIRECT READING INSTRUMENTS: Methods of detection in commercially available devices which may be suitable: Electrical conductivity analyzer, coulometric analyzer, flame ionization detector, heat of combustion detector, colorimetric analyzer, infrared photometer, ultraviolet and visible light photometer, photoionization analyzer, gas chromatograph analyzer, infrared photoacoustic analyzer.
COLORIMETRIC DETECTOR TUBES: Commercially available.
ENGINEERING CONTROLS :
Provide properly designed and maintained mechanical ventilation systems, including local exhaust and dilution (general) ventilation to reduce levels of the airborne contaminant, as indicated by a hazard assessment. Administrative controls and personal protective equipment may also be required. Local exhaust ventilation and/or process enclosure is usually necessary to control airborne mist and vapour. Supply sufficient replacement air to make up for air removed by exhaust systems. Treatment of exhaust

emissions to prevent environmental contamination may be required.

PERSONAL PROTECTIVE EQUIPMENT :

If engineering controls and work practices are not effective in controlling exposure to this material, then wear suitable personal protective equipment including approved respiratory protection. Have appropriate equipment available for use in emergencies such as spills or fire. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training and maintenance and inspection. Refer to the CSA Standard Z94.4-93, "Selection, Care and Use of Respirators", available from the Canadian Standards Association, Rexdale, Ontario, M9W 1R3.

RESPIRATORY PROTECTION GUIDELINES :

NIOSH RECOMMENDATIONS FOR METHYLENE CHLORIDE CONCENTRATIONS IN AIR (4):
AT ANY DETECTABLE CONCENTRATION: Positive pressure, full- facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.
ESCAPE: Gas mask with organic vapour canister; or escape-type SCBA.
NOTE: The IDLH concentration for methylene chloride is 5000 ppm. Carcinogenic effects of this compound were not considered in determining the IDLH value.
NOTE: NIOSH has classified this material as a potential occupational carcinogen, according to specific NIOSH criteria. This classification is reflected in these recommendations for respiratory protection, which specify that only the most reliable and protective respirators be worn at any detectable concentration. The requirements in Canadian jurisdictions may vary.
ABBREVIATIONS: SAR = supplied-air respirator; SCBA = self- contained breathing apparatus; IDLH = Immediately dangerous to life or health.
NOTE: In these recommendations the IDLH concentration is defined as the maximum concentration which would not cause any escape- impairing symptoms or irreversible health effects to a person exposed for 30 minutes if the respirator failed.
Recommendations apply only to NIOSH and MSHA (Mine Safety and Health Administration) approved respirator.

EYE/FACE PROTECTION :

Chemical safety goggles suitable for splash protection and/or a face shield.

SKIN PROTECTION :

Impervious gloves, aprons, coveralls, boots and/or other resistant protective clothing. Have a safety shower/eye-wash fountain readily available in the immediate work area.

RESISTANCE OF MATERIALS FOR PROTECTIVE CLOTHING :

GOOD: Viton/neoprene, Silvershield (18) polyvinyl alcohol.(32) FAIR/POOR: Butyl, natural rubber, neoprene, nitrile, polyethylene, polyvinyl chloride (PVC), neoprene+natural rubber, polyvinyl alcohol (PVA), chlorinated polyethylene (CPE), nitrile+PVC, Viton, butyl/neoprene, Viton/chlorobutyl, Teflon.(18) NOTE: Resistance of specific materials can vary from product to product. Evaluate resistance under conditions of use and maintain clothing carefully.

EXPOSURE CONTROLS/PERSONAL PROTECTION COMMENTS :

Remove contaminated clothing promptly. Keep contaminated clothing closed containers. Discard or launder before rewearing. Inform laundry personnel of contaminant's hazards. Do not smoke, eat or drink in work areas. Wash hands thoroughly after handling this material. Maintain good housekeeping.

** EXPOSURE GUIDELINES **

* THRESHOLD LIMIT VALUES (TLVs) / AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH) / 1994-95 *

IME-WEIGHTED AVERAGE (TLV-TWA) : 50 ppm (174 mg/m3) - Carcinogen A2 (suspected human carcinogen)

TLV COMMENTS :
NOTE: In many Canadian jurisdictions, exposure limits are similar to the ACGIH TLVs. Since the manner in which exposure limits are established, interpreted and implemented can vary, obtain detailed information from the appropriate government agency in each jurisdiction.
CARCINOGEN A2 - Suspected Human Carcinogen: Substance is carcinogenic in laboratory animals under conditions that are considered relevant to worker exposure. Available human studies are conflicting or insufficient to confirm an increased risk of cancer in exposure humans. Worker exposure to an A2 carcinogen should be controlled to levels as low as reasonably achievable below the TLV.

* PERMISSIBLE EXPOSURE LIMITS (PELs) / FINAL RULE LIMITS / OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) *

IME WEIGHTED AVERAGE (PEL-TWA) : 500 ppm
SHORT TERM EXPOSURE LIMIT (PEL-TWA) :
2000 ppm (5 min in any 3 hrs)
EILING EXPOSURE LIMIT (PEL-C) : 1000 ppm
INAL RULE LIMIT PEL COMMENTS :
NOTE: Methylene chloride will be specifically regulated in 29 CFR 1910.1052. Please refer to this proposed regulation for additional information.

NOTE: The OSHA PEL Final Rule Limits are currently non-enforceable due to a court decision. The OSHA PEL Transitional Limits are now in force.

*** SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES ***

OLECULAR WEIGHT : 84.94
ONVERSION FACTOR :
1 ppm = 3.48 mg/m3; 1 mg/m3 = 0.287 ppm at 20 deg C (21)
ELTING POINT : -97 deg C (-142 deg F) (3)
OILING POINT : 39.8 deg C (103.6 deg F) (1,21)
ELATIVE DENSITY (SPECIFIC GRAVITY) :
1.3266 (water=1) (1,5)
OLUBILITY IN WATER :
Moderately soluble (2 g/100 mL at 20 deg C) (3,5)
OLUBILITY IN OTHER LIQUIDS :
Soluble in most organic solvents such as ethanol, ether, phenols, aldehydes, and ketones.
APOUR DENSITY : 2.93 (air = 1) (3,21)
VAPOUR PRESSURE : 400 mm Hg at 24 deg C (11)
ATURATION VAPOUR CONCENTRATION : 54.4% at 24 deg C (calculated)
VAPORATION RATE : 27.5 (butyl acetate = 1)
pH VALUE : Not available
RITICAL TEMPERATURE : 245 deg C (437 deg F) (21)
OEFFICIENT OF OIL/WATER DISTRIBUTION (PARTITION COEFFICIENT) :
Log P(oct) = 1.25 (1)
OTHER PHYSICAL PROPERTIES :
VISCOSITY: 0.43 centipoises (mPa.s) at 20 deg C (21)

*** SECTION 10. STABILITY AND REACTIVITY ***

STABILITY :
Normally stable. On prolonged contact with water, slowly decomposes forming hydrochloric acid.
HAZARDOUS POLYMERIZATION :
Does not occur
CONDITIONS TO AVOID :
Temperatures above 100 deg C
INCOMPATIBILITY - MATERIALS TO AVOID :
ALUMINUM POWDER - reacts exothermically and uncontrollably when mixed with methylene chloride above 95 deg C under appropriate pressure.(20)
AMINES - Reacts exothermically.(20)
AZIDE FORM OF QUATERNARY ION EXCHANGE RESINS - when methylene chloride was used as a solvent in the preparation of alkyl azides, a violent explosion occurred after the reaction mixture was left to stand for 7 days (due to the production of diazidomethane).(20)
DIMETHYL SULFOXIDE (DMSO) AND PERCHLORIC ACID - a violent explosion occurred when a syringe used for DMSO was rinsed with methylene chloride and then filled with perchloric acid.(20)
REACTIVE MATERIALS (e.g. lithium, sodium, potassium) - forms an explosive mixture.(19,20)
NITRIC ACID - Produces a detonable solution.(20)
N-METHYL-N-NITROSO UREA - a mixture of 40% potassium hydroxide and methylene chloride detonated when N-methyl-N-nitroso urea was added.(19)
POTASSIUM TERT-BUTOXIDE - forms an explosive mixture.(19,20)
CORROSIVITY TO METALS :
When dry (no water present) methylene chloride is not corrosive to metals. At high temperature and in presence of water, methylene chloride can corrode iron, some stainless steels, copper, aluminum.

*** SECTION 11. TOXICOLOGICAL INFORMATION ***

LC50 (guinea pig): 11600 ppm (6-hour exposure) (7)
LC50 (rat): 57000 ppm (15-minute exposure) (8)
LC50 (mouse): 16186 ppm (8-hour exposure) (9)
LD50 (oral, rat): 2100 to 3000 mg/kg (1)
SKIN IRRITATION (rabbit): Application to intact and abraded skin resulted in severe irritation.(3)
EYE IRRITATION (Rabbit): Application of 0.01 mL and 0.1 mL resulted in moderate to severe irritation.(3)
EFFECTS OF SHORT-TERM INHALATION: Methylene chloride depressed the central nervous system (CNS) of rats exposed for 10 minutes to extremely high concentrations (7000-12000 ppm).(8) Symptoms included muscular incoordination, loss of righting reflex, stupor and shallow respiration. Cardiac arrhythmias have occurred in dogs inhaling 500-5000 ppm.(3) Cardiac sensitization to adrenaline was produced in dogs exposed for 5 minutes to 1.9-3.4% (19000-34000 ppm).(8) Elevated levels of carboxyhemoglobin (a reversible condition of carbon monoxide binding to red blood cells) were seen in guinea pigs exposed to 560, 5000 and 11000 ppm methylene chloride for 6 hours.(7) Elevated carboxyhemoglobin levels were also seen in dogs, monkeys and rats exposed for 24 hours to 5000 ppm. Methylene chloride is metabolized to carbon monoxide in animals.(13) Carboxyhemoglobin is formed by carbon monoxide.
EFFECTS OF LONG-TERM INHALATION: Liver injury was seen in male and female rats exposed to 1000 ppm during a two-year study. Kidney injury was also seen in male rats exposed to 2000 ppm and in female rats exposed to 4000 ppm in the same study.(13) Slight liver effects and kidney injury were seen

in rats exposed to 25 or 100 ppm methylene chloride continuously for up to 100 days. Slight liver effects were also seen in mice exposed to 100 ppm methylene chloride continuously for up 100 days. Increased carboxyhemoglobin levels were seen in monkeys exposed for a similar period to 25 or 100 ppm and in dogs exposed to 100 ppm.(14)
CARCINOGENICITY: Rats exposed by inhalation to 1000, 2000 and 4000 ppm for 2 years had a higher incidence of benign mammary gland tumours (male and female). In the same study, there was increased incidence of lung and liver tumours in mice exposed for 2 years to 2000 and 4000 ppm.(13) In another study, rats were exposed to 500, 1500 and 3500 ppm for two years. A dose-related increase in benign mammary gland tumours (male and females) and sarcomas located in the neck (males) was observed.(1)
Oral administration of dichloromethane to mice caused an increased incidence of lung tumours (male) and malignant mammary gland tumours (female).(6) Other studies, by oral administration, in rats and mice and an inhalation study in hamsters, have given negative or inconclusive results.(1)
IARC evaluation of the carcinogenicity of dichloromethane to experimental animals: Sufficient evidence.(1)
TERATOGENICITY, FETOTOXICITY AND EMBRYOTOXICITY: Slight fetotoxicity (decreased fetal body weight) and maternal toxicity (increased liver weights, increased carboxyhemoglobin levels) were seen following exposure of female rats to 4500 ppm for 12-14 days prior to gestation and/or during days 1-17 of gestation. No embryotoxic or teratogenic effects were seen.(10) Signs of slight behavioral changes (slow environmental habituation) were seen in the offspring of rats exposed to 4500 ppm for about 21 days before and/or throughout days 1-17 of gestation. No teratogenic effects were seen. Mothers had increased carboxyhemoglobin levels and liver weights.(11) No embryotoxic, fetotoxic or teratogenic effects seen when mice and rats were exposed to 1250 ppm methylene chloride during days 6-16 of gestation. Increased carboxyhemoglobin levels were seen in the pregnant animals.(12)
REPRODUCTIVE EFFECTS: Testicular atrophy was seen in mice exposed daily to 2000 or 4000 ppm for a two year period.(13) There were no effects observed in rats exposed to concentrations up to 1500 ppm in a two generation reproductive study.(28)
MUTAGENICITY: Dichloromethane was mutagenic in several studies using bacteria and yeast and in three test systems using cultured mammalian cells (chromosome aberrations, sister-chromatid exchange and cell transformation). Negative results were obtained in some mammalian cell tests (unscheduled DNA synthesis) and in two in vivo test systems using whole animals (micronuclei and chromosome aberration).(1)
IARC evaluation: Sufficient evidence in short-term tests for genetic activity.

*** SECTION 12. ECOLOGICAL INFORMATION ***

NOTE : This section is under development.

*** SECTION 13. DISPOSAL CONSIDERATIONS ***

Review federal, provincial and local government requirements prior to disposal. Store material for disposal as indicated in Storage Conditions. Recycle by distillation in a fume hood or dispose of by secure landfill or by controlled incineration. This may produce hydrogen chloride and phosgene gases, and therefore, treatment of exhaust emissions to remove these gases will required. Contact government or environmental authorities for advice.

*** SECTION 14. TRANSPORT INFORMATION ***

** TRANSPORTATION OF DANGEROUS GOODS (TDG) SHIPPING INFORMATION **

SHIPPING NAME AND DESCRIPTION: Dichloromethane or Methylene chloride (R30)
PRODUCT IDENTIFICATION NUMBER (PIN): 1593
CLASSIFICATION: 6.1 - Poisonous substance
SPECIAL PROVISIONS: --
PACKING GROUP: III
REGULATED LIMIT: --

NOTE: This information incorporates Schedule No. 18 amendments to the Transportation of Dangerous Goods Act, 1992, effective October 1, 1994.

*** SECTION 15. REGULATORY INFORMATION ***

** WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS) **

ROPOSED WHMIS CLASSIFICATION :
D1B - Poisonous and infectious material - immediate and serious effects - toxic
D2A - Poisonous and infectious material - other effects - very toxic
WHMIS HEALTH EFFECTS :
Eye irritation - toxic - other
Skin irritation - toxic - other
Carcinogenicity - very toxic - other
TDG class 6.1 group III - toxic - immediate
HMIS INGREDIENT DISCLOSURE LIST :
Included for disclosure at 0.1% or greater
DETAILED WHMIS CLASSIFICATION ACCORDING TO CRITERIA :
CLASS A - COMPRESSED GAS: Does not meet criteria.
CLASS B - FLAMMABLE & COMBUSTIBLE: Does not meet criteria.
CLASS C - OXIDIZING MATERIAL: Does not meet criteria.
CLASS D - POISONOUS AND INFECTIOUS MATERIAL. DIVISION 1 - IMMEDIATE AND SERIOUS TOXIC EFFECTS: Meets criteria for "Toxic material".
Acute Lethality: Does not meet criteria.
Transportation of Dangerous Goods (TDG): "Toxic"; class 6.1, packing group III.
CLASS D - POISONOUS AND INFECTIOUS MATERIAL. DIVISION 2 - OTHER TOXIC EFFECTS: Meets criteria for "Very toxic material". See detailed evaluation below.
Chronic Toxic Health Effects: Does not meet criteria.
Carcinogenicity: "Very toxic"; listed in Appendix A of TLV booklet and as a group 2B carcinogen by IARC.
Teratogenicity and Embryotoxicity: Does not meet criteria; not teratogenic or embryotoxic in animal test.(10,11,12)
Mutagenicity: Does not meet criteria; negative in in vivo tests.
Reproductive Toxicity: Insufficient information. Testicular atrophy in mice.(13)
Respiratory Tract Sensitization: Does not meet criteria; not reported as human respiratory sensitizer.
Skin Sensitization: Insufficient information.
Skin Irritation: "Toxic"; severe irritant.
Eye Irritation: "Toxic"; moderate to severe irritant.
CLASS E - CORROSIVE MATERIAL: Insufficient information.
CLASS F - DANGEROUSLY REACTIVE MATERIAL: Does not meet criteria.

OSHA HAZARD COMMUNICATION EVALUATION :
Meets criteria for hazardous material, as defined by 29 CFR 1910.1200.

*** SECTION 16. OTHER INFORMATION ***

SELECTED BIBLIOGRAPHY :

(1) IARC Monographs on the evaluation of the carcinogenic risk of chemicals to humans. Vol. 41. IARC, 1986. p. 43-68
(2) Criteria for a recommended standard: occupational exposure to methylene chloride. NIOSH, 1976
(3) Illing, H.P.A., et al. Toxicity review 12 : dichloromethane (methylene chloride). Her Majesty's Stationery Office, 1985
(4) NIOSH pocket guide to chemical hazards. NIOSH, June 1990. p.150-151
(5) Organo-chlorine solvents: health risk to workers. Royal Society of Chemistry, 1986. p. 147-173
(6) IARC monographs on the evaluation of carcinogenic risks to humans. Supplement 7. IARC, 1987. p. 194-195
(7) Balmer, M.F., et al. Effects in the liver of methylene chloride inhaled alone and with ethyl alcohol. American Industrial Hygiene Association Journal. Vol. 37, no. 6 (June 1976). p. 345- 352
(8) Clark, D.G., et al. Acute inhalation toxicity of some halogenated and non-halogenated hydrocarbons. Human Toxicology. Vol. 1, no. 3 (1982). p. 239-247
(9) Svirbely, J.L., et al. The toxicity and narcotic action of mono-chloro-mono-bromo-methane with special reference to inorganic and volatile bromide in blood, urine and brain. Journal of Industrial Hygiene and Toxicology. Vol. 29 (Nov. 1947). p. 382- 389
(10) Hardin, B.D., et al. Absence of dichloromethane teratogenicity with inhalation exposure in rats. Toxicology and Applied Pharmacology. Vol. 52, no. 1 (Jan. 1980). p. 22-28
(11) Bornschein, R.L., et al. Behavioral toxicity in the offspring of rats following maternal exposure to dichloromethane. Toxicology and Applied Pharmacology. Vol. 52, no. 1 (Jan. 1979). p. 29-37
(12) Schwetz, B.A., et al. The effect of maternally inhaled trichloroethylene, perchloroethylene, methyl chloroform, and methylene chloride on embryonal and fetal development in mice and rats. Toxicology and Applied Pharmacology. Vol. 32 (1975). p. 84-96
(13) NTP technical report on the toxicology and carcinogenesis studies of dichloromethane (methylene chloride) (CAS no. 75-09-2) in F344/N rats and B6C3F1 mice (inhalation studies) (NIH publication no. 86-2562). NIOSH, January 1986
(14) Haun, C.C., et al. Continuous animal exposure to low levels of dichloroemethane (report no. AMRL-TR-72-130). Aerospace Medical Research Laboratories, 1972
(15) Stewart, R.D., et al. Methylene chloride : development of a biologic standard for the industrial worker by breath analysis. NIOSH, 1974
(16) Stewart, R.D., et al. Absorption of carbon tetrachloride, trichloroethylene, tetrachloroethylene, methylene chloride, and 1,1,2-trichloroethane through the human skin. Industrial Hygiene Journal (Sept-Oct 1964). p. 439-446
(17) Stewart, R.D., et al. Experimental human exposure to methylene chloride. Archives of Environmental Health. Vol. 25 (Nov. 1972). p. 342-348
(18) Schwope, A.D., et al. Guidelines for the selection of chemical protective clothing. Vol. 1. 3rd ed. ACGIH, 1987. p. 87
(19) Fire protection guide to hazardous materials. 10th ed. National Fire Protection Association, 1991. p. 49-113 to 49-114, 325M-68, 491M-117,

491M-131, 491M-132, 491M-171, 491M-199
(20) Bretherick, L. Handbook of reactive chemical hazards. 3rd ed. Butterworths, 1990. p. 24, 35, 141-142, 457, 957, 1158, 1352, 1691
(21) Kirk-Othmer encyclopedia of chemical technology. Vol. 5. 3rd ed. John Wiley & Sons, 1979. p. 686-693
(22) Roberts, C.J.C., et al. Recovery after "lethal" quantity of paint remover. British Medical Journal. Vol. 1 (3 Jan. 1976). p. 20-21
(23) Wells, G.G., et al. Methylene chloride burns. British Journal of Industrial Medicine. Vol. 41 (1984). p. 420
(24) Winneke, G. The neurotoxicity of dichloroemthane. Neurobehavioral Toxicology and Teratology. Vol. 3, no. 4 (1981). p. 391-395
(25) Barrowcliffe, D.F., et al. Cerebral damage due to endogenous chronic carbon monoxide poisoning caused by exposure to methylene chloride. Journal of the Society of Occupational Medicine. Vol. 29 (1979). p. 12-14
(26) Tariot, P.M. Delirium resulting from methylene chloride exposure : case report. Journal of Clinical Psychiatry. Vol. 44, no. 9 (1983). p. 340-342
(27) Odor thresholds for chemicals with established occupational health standards. ACGIH, 1989. p. 23
(28) Nitschke, K.D., et al. Methylene chloride : two generation inhalation reproductive study in rats. Fundamental and Applied Toxicology. Vol. 11 (1988). p. 60-67
(29) Kelly, M. Case reports of individuals with oligospermia and methylene chloride exposures. Reproductive Toxicology. Vol. 2 (1988). p. 13-17
(30) Soden, K.J. An evaluation of chronic methylene chloride exposure. Journal of Occupational Medicine. Vol. 35, no. 3 (March 1993). p. 282-286
(31) Wilcosky, T.C., et al. Solvent exposure and cardiovascular disease. American Journal of Industrial Medicine. Vol. 19 (1991). p. 569-586
(32) Vahdat, N. Permeation of protective clothing materials by methylene chloride and perchloroethylene. American Industrial Hygiene Association Journal. Vol. 48, no.7 (1987). p. 646-651
(33) Seventh Annual Report on Carcinogens, Summary. U.S. Department of Health and Human Services, 1994.

Information on chemicals reviewed in the CHEMINFO database is drawn from a number of publicly available sources. A list of general references used to compile CHEMINFO records is available in the database Help.

REVIEW/PREPARATION DATE :
1993-10-20
REVISION INDICATORS :
TDG; 1994-02
WHMIS (detailed class); 1994-03
WHMIS (proposed class); 1994-09
Sampling; 1994-09
HANDLING AND STORAGE; 1994-09

* *
* M S D S *
* Canadian Centre for Occupational Health and Safety *
* * * * * * * * * * * * * * Issue : 95-1 (February, 1995) *

*** IDENTIFICATION ***

MSDS RECORD NUMBER : 836361
PRODUCT NAME(S) : METHYLENE CHLORIDE
PRODUCT IDENTIFICATION : J.T. BAKER MSDS NUMBER: M4420
CAS NO.: 75-09-2
PRODUCT CODES: 9330 9341 5378 9348 9315 5531 9128
9128 9313 Q480 9324 9329 9266 9264
DATE OF MSDS : 1994-09-27

*** MANUFACTURER INFORMATION ***

MANUFACTURER : J T BAKER INC
ADDRESS : 222 RED SCHOOL LANE
PHILLIPSBURG NEW JERSEY
U.S.A. 08865
EMERGENCY TELEPHONE NO. : 908-859-2151 (24-HOURS) 800-424-9300 (CHEMTREC)
800-424-8802 (NATIONAL RESPONSE CENTER)

*** MATERIAL SAFETY DATA ***

J.T.BAKER INC. 222 RED SCHOOL LANE, PHILLIPSBURG, NJ 08865
M A T E R I A L S A F E T Y D A T A S H E E T
24-HOUR EMERGENCY TELEPHONE -- (908) 859-2151
CHEMTREC # (800) 424-9300 -- NATIONAL RESPONSE CENTER # (800) 424-8802

J.T.BAKER INC., 222 RED SCHOOL LANE, PHILLIPSBURG, NJ 08865

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: METHYLENE CHLORIDE
COMMON SYNONYMS: DICHLOROMETHANE; METHYLENE DICHLORIDE; METHANE DICHLORIDE
CHEMICAL FAMILY: CHLORINATED HYDROCARBONS
FORMULA: CH2CL2
FORMULA WT.: 84.93
CAS NO.: 75-09-2
NIOSH/RTECS NO.: PA8050000
PRODUCT USE: LABORATORY REAGENT
PRODUCT CODES: 9330,9341,5378,9348,9315,5531,9128,9128,9313,Q480,9324,9329
9266,9264

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* SYSTEM

HEALTH	-	3	SEVERE (CANCER CAUSING)
FLAMMABILITY	-	1	SLIGHT
REACTIVITY	-	1	SLIGHT
CONTACT	-	2	MODERATE

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

U.S. PRECAUTIONARY LABELING

WARNING

MAY BE FATAL IF SWALLOWED OR INHALED. CAUSES IRRITATION. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE. EXCEPTIONAL CONTACT HAZARD: READ MATERIAL SAFETY DATA SHEET.
KEEP AWAY FROM HEAT, MOISTURE, AND DIRECT SUNLIGHT. AVOID CONTACT WITH EYES, SKIN, CLOTHING. DO NOT BREATHE VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF SPILL, SOAK UP WITH SAND OR EARTH.

CONTINUED ON PAGE: 2

PRECAUTIONARY LABELING (CONTINUED)

INTERNATIONAL LABELING

HARMFUL BY INHALATION. POSSIBLE RISKS OF IRREVERSIBLE EFFECTS.
AVOID CONTACT WITH SKIN.

SAF-T-DATA* STORAGE COLOR CODE: BLUE (HEALTH)

SECTION II - COMPONENTS

COMPONENT	CAS NO.	WEIGHT %	OSHA/PEL	ACGIH/TLV
METHYLENE CHLORIDE	75-09-2	98-100	500 PPM	50 PPM

CONTAINS 400 TO 600 PPM OF ISO-AMYLENE AS A PRESERVATIVE.

SECTION III - PHYSICAL DATA

BOILING POINT: 40 C (104 F)
(AT 760 MM HG)

VAPOR PRESSURE (MMHG): 350
(20 C)

MELTING POINT: -95 C (-139 F)
(AT 760 MM HG)

VAPOR DENSITY (AIR=1): 2.9

SPECIFIC GRAVITY: 1.32
(H2O=1)

EVAPORATION RATE: 27.5
(BUTYL ACETATE = 1)

SOLUBILITY(H20): MODERATE (1-10%)

% VOLATILES BY VOLUME: 100
(21 C)

PH: N/A

ODOR THRESHOLD (P.P.M.): N/A

PHYSICAL STATE: LIQUID

COEFFICIENT WATER/OIL DISTRIBUTION: N/A

APPEARANCE & ODOR: CLEAR, COLORLESS LIQUID. ETHER-LIKE ODOR.

CONTINUED ON PAGE: 3

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP): N/A

NFPA 704M RATING: 2-1-0

AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: UPPER - N/A LOWER - N/A

FIRE EXTINQUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES

FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS

CONCENTRATED VAPOR CAN BE IGNITED BY A HIGH INTENSITY IGNITION SOURCE. VAPOR MAY FORM FLAMMABLE MIXTURE IN ATMOSPHERE THAT CONTAINS A HIGH PERCENTAGE OF OXYGEN. CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE.

TOXIC GASES PRODUCED

HYDROGEN CHLORIDE, PHOSGENE, CHLORINE, CARBON MONOXIDE, CARBON DIOXIDE

EXPLOSION DATA-SENSITIVITY TO MECHANICAL IMPACT

NONE IDENTIFIED.

EXPLOSION DATA-SENSITIVITY TO STATIC DISCHARGE

NONE IDENTIFIED.

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 174 MG/M (50 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): NOT ESTABLISHED

PERMISSIBLE EXPOSURE LIMIT (PEL): (500 PPM)

PEL (CEILING) = 1000 PPM.

CONTINUED ON PAGE: 4

SECTION V - HEALTH HAZARD DATA (CONTINUED)

TOXICITY OF COMPONENTS

ORAL RAT LD50 FOR METHYLENE CHLORIDE 2136 MG/KG
INTRAPERITONEAL MOUSE LD50 FOR METHYLENE CHLORIDE 437 MG/KG
SUBCUTANEOUS MOUSE LD50 FOR METHYLENE CHLORIDE 6460 MG/KG
INHALATION-30MIN RAT LC50 FOR METHYLENE CHLORIDE 88 G/M
CARCINOGENICITY: NTP: NO IARC: YES Z LIST: NO OSHA REG: NO

CARCINOGENICITY

THIS SUBSTANCE IS LISTED AS AN IARC PROBABLE HUMAN CARCINOGEN (GROUPS 2A AND 2B).

REPRODUCTIVE EFFECTS

TESTS ON LABORATORY ANIMALS INDICATE MATERIAL MAY BE MUTAGENIC.

EFFECTS OF OVEREXPOSURE

INHALATION: HEADACHE, NAUSEA, VOMITING, DIZZINESS, NARCOSIS, WEAKNESS, FATIGUE, IRRITATION OF UPPER RESPIRATORY TRACT, CENTRAL NERVOUS SYSTEM DEPRESSION, CAUSES METHEMOGLOBULIN FORMATION IN THE BLOOD, PULMONARY EDEMA, UNCONSCIOUSNESS, AND MAY BE FATAL.

SKIN CONTACT: IRRITATION, MAY BE HARMFUL, PROLONGED CONTACT MAY CAUSE DERMATITIS

EYE CONTACT: IRRITATION, MAY CAUSE TEMPORARY CORNEAL DAMAGE

SKIN ABSORPTION: NONE IDENTIFIED

INGESTION: HEADACHE, NAUSEA, VOMITING, DIZZINESS, NARCOSIS, WEAKNESS, FATIGUE, GASTROINTESTINAL IRRITATION, CENTRAL NERVOUS SYSTEM DEPRESSION, CAUSES METHEMOGLOBULIN FORMATION IN THE BLOOD, UNCONSCIOUSNESS, AND MAY BE FATAL.

CHRONIC EFFECTS: DAMAGE TO LIVER, KIDNEYS, LUNGS, BLOOD, CENTRAL NERVOUS SYSTEM

TARGET ORGANS

RESPIRATORY SYSTEM, LUNGS, CARDIOVASCULAR SYSTEM, CENTRAL NERVOUS SYSTEM, LIVER, KIDNEYS, EYES, SKIN

CONTINUED ON PAGE: 5

SECTION V - HEALTH HAZARD DATA (CONTINUED)

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

CARDIOVASCULAR DISORDERS, HEART DISORDERS, LIVER OR KIDNEY DISORDERS, CENTRAL NERVOUS SYSTEM DISORDERS, HEAVY DRINKERS, HEAVY SMOKERS

PRIMARY ROUTES OF ENTRY

INHALATION, INGESTION, SKIN CONTACT, EYE CONTACT, ABSORPTION

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: CALL A PHYSICIAN. IF SWALLOWED, DO NOT INDUCE VOMITING.

INHALATION: IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN. PROMPT ACTION IS ESSENTIAL.

SKIN CONTACT: IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. WASH CLOTHING BEFORE RE-USE.

EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ACUTE: YES CHRONIC: YES FLAMMABILITY: NO PRESSURE: NO REACTIVITY: NO

EXTREMELY HAZARDOUS SUBSTANCE:	NO	
CERCLA HAZARDOUS SUBSTANCE:	YES	CONTAINS METHYLENE CHLORIDE (RQ = 1000 LBS)
SARA 313 TOXIC CHEMICALS:	YES	CONTAINS DICHLOROMETHANE (METHYLENE CHLORIDE)
GENERIC CLASS:		GENERIC CLASS REMOVED FROM CFR: 7/1/91
TSCA INVENTORY:	YES	

STATE LISTS: FOR PRODUCTS SOLD IN THE STATE OF CALIFORNIA, THE STATE REQUIRES THAT WE PROVIDE TO USERS AND THEIR EMPLOYEES THE FOLLOWING MESSAGE: WARNING: THIS PRODUCT IS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER. NJ SPECIAL HEALTH HAZARDOUS SUBSTANCE NY HAZARDOUS SUBSTANCES THIS SUBSTANCE IS INCLUDED IN PENNSYLVANIA'S HAZARDOUS SUBSTANCE LIST AS SUBJECT TO REPORTING.

CONTINUED ON PAGE: 6

SECTION VI - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION, MOISTURE, LIGHT

INCOMPATIBLES: ALKALI METALS, STRONG OXIDIZING AGENTS, STRONG BASES, OXIDES OF NITROGEN, ZINC, ALUMINUM, WATER, MAGNESIUM, AMINES, PLASTICS, RUBBER, SODIUM, POTASSIUM

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, PHOSGENE, CHLORINE, CARBON MONOXIDE, CARBON DIOXIDE

SECTION VII - SPILL & DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE

WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U080 (TOXIC WASTE)

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS ABOVE 100 PPM, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SOLVENT RESISTANT GLOVES SHOULD BE WORN, SUCH AS VITON, POLYVINYL ALCOHOL, OR EQUIVALENT. GLOVES CONTAMINATED WITH PRODUCT SHOULD BE DISCARDED.

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SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT (CONTINUED)

SAFETY GOGGLES AND FACE SHIELD, UNIFORM,PROTECTIVE SUIT, POLYVINYL ALCOHOL GLOVES ARE RECOMMENDED.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* STORAGE COLOR CODE: BLUE (HEALTH)

STORAGE REQUIREMENTS

KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA. KEEP CONTAINERS OUT OF SUN AND AWAY FROM HEAT.

SPECIAL PRECAUTIONS

MATERIAL IS HYGROSCOPIC.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: DICHLOROMETHANE
HAZARD CLASS: 6.1
UN/NA: UN1593 REPORTABLE QUANTITY: 1000 LBS. PACKAGING GROUP: III
LABELS: KEEP AWAY FROM FOOD
REGULATORY REFERENCES: 49CFR 172.101

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: DICHLOROMETHANE
HAZARD CLASS: 6.1 I.M.O. PAGE: 6127
UN: UN1593 MARINE POLLUTANTS: NO PACKAGING GROUP: III
LABELS: HARMFUL - STOW AWAY FROM FOOD STUFFS
REGULATORY REFERENCES: 49CFR PART 176; IMDG CODE

AIR (I.C.A.O.)

PROPER SHIPPING NAME: DICHLOROMETHANE

HAZARD CLASS: 6.1
UN: UN1593 PACKAGING GROUP: III
LABELS: KEEP AWAY FROM FOOD

CONTINUED ON PAGE: 8

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION (CONTINUED)

REGULATORY REFERENCES: 49CFR PART 175; ICAO=== WE BELIEVE THE TRANSPORTATION DATA AND REFERENCES CONTAINED HEREIN TO BE FACTUAL AND THE OPINION OF QUALIFIED EXPERTS. THE DATA IS MEANT AS A GUIDE TO THE OVERALL CLASSIFICATION OF THE PRODUCT AND IS NOT PACKAGE SIZE SPECIFIC, NOR SHOULD IT BE TAKEN AS A WARRANTY OR REPRESENTATION FOR WHICH THE COMPANY ASSUMES LEGAL RESPONSIBILITY.=== THE INFORMATION IS OFFERED SOLELY FOR YOUR CONSIDERATION, INVESTIGATION, AND VERIFICATION. ANY USE OF THE INFORMATION MUST BE DETERMINED BY THE USER TO BE IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL LAWS AND REGULATIONS. SEE SHIPPER REQUIREMENTS 49CFR 171.2, CERTIFICATION 172.204, AND EMPLOYEE TRAINING 49 CFR 173.1(B).

U.S. CUSTOMS HARMONIZATION NUMBER: 29031200000

EPA/TSCA EXPORT NOTIFICATION

YES

NOTE: WHEN HANDLING LIQUID PRODUCTS, SECONDARY PROTECTIVE CONTAINERS MUST BE USED FOR CARRYING.
N/A = NOT APPLICABLE, OR NOT AVAILABLE;
N/E = NOT ESTABLISHED.-
THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE REQUIREMENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ACT AND REGULATIONS PROMULGATED THEREUNDER (29 CFR 1910.1200 ET. SEQ.) AND THE CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS DOCUMENT IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF THE MATERIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON TRAINED IN, CHEMICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE PRECAUTIONS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR APPLICATION. DEPENDING ON USAGE, PROTECTIVE CLOTHING INCLUDING EYE AND

FACE GUARDS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH MATERIAL OR BREATHING CHEMICAL VAPORS/FUMES.
EXPOSURE TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS CHEMICAL MAY INTERACT WITH OTHER SUBSTANCES. SINCE THE POTENTIAL USES ARE SO VARIED, BAKER CANNOT WARN OF ALL OF THE POTENTIAL DANGERS OF USE OR INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT THE CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL.
BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS
CONTINUED ON PAGE: 9

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FOR A PARTICULAR PURPOSE.
THE USER SHOULD RECOGNIZE THAT THIS PRODUCT CAN CAUSE SEVERE INJURY AND EVEN DEATH, ESPECIALLY IF IMPROPERLY HANDLED OR THE KNOWN DANGERS OF USE ARE NOT HEEDED. READ ALL PRECAUTIONARY INFORMATION. AS NEW DOCUMENTED GENERAL SAFETY INFORMATION BECOMES AVAILABLE, BAKER WILL PERIODICALLY REVISE THIS MATERIAL SAFETY DATA SHEET.
NOTE: CHEMTREC, CANUTEC, AND NATIONAL RESPONSE CENTER EMERGENCY TELEPHONE NUMBERS ARE TO BE USED ONLY IN THE EVENT OF CHEMICAL EMERGENCIES INVOLVING A SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT INVOLVING CHEMICALS. ALL NON-EMERGENCY QUESTIONS SHOULD BE DIRECTED TO CUSTOMER SERVICE (1-800-JTBAKER) FOR ASSISTANCE.

===
APPROVED BY QUALITY ASSURANCE DEPARTMENT.

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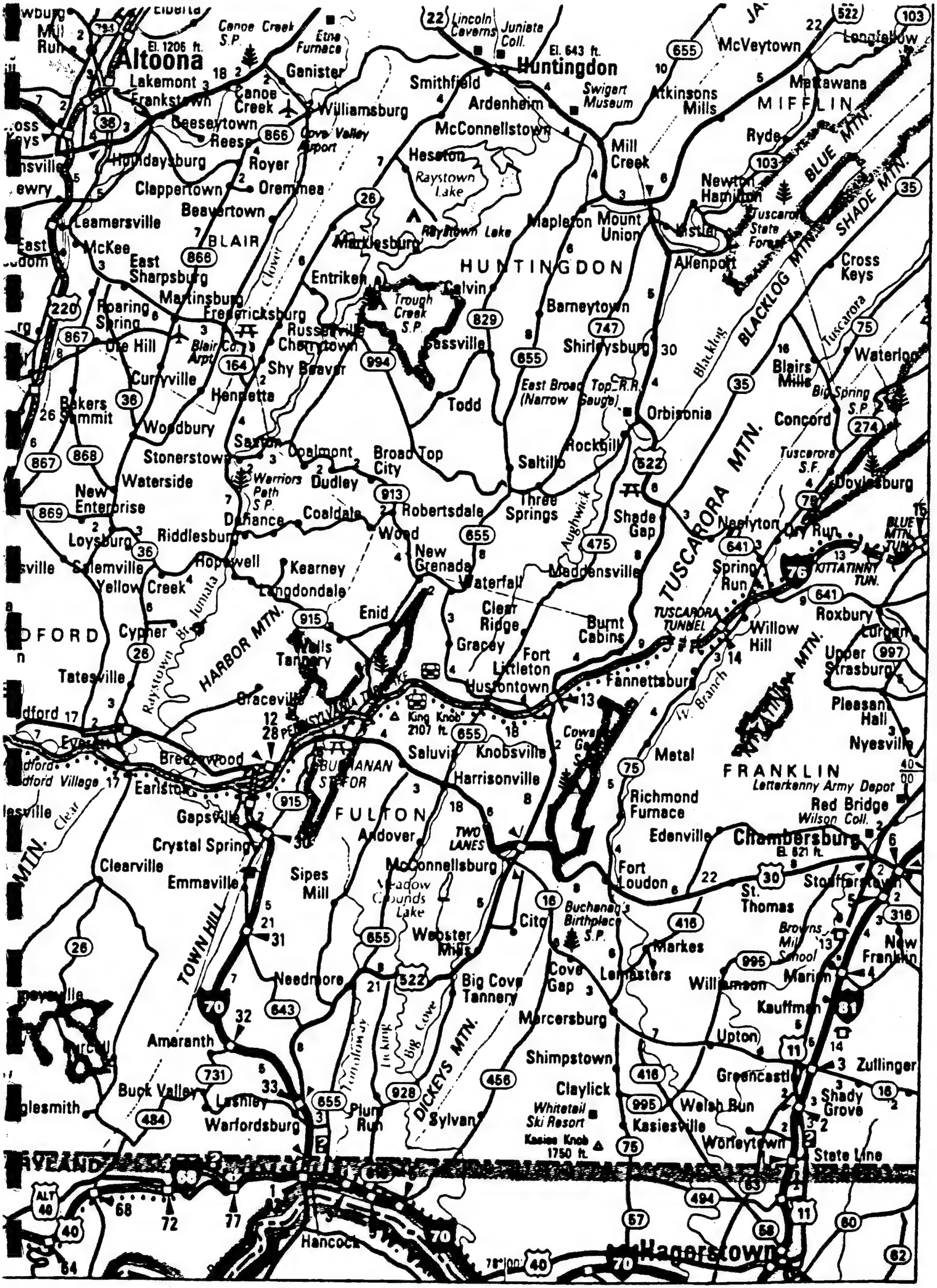
APPENDIX B

SITE AND HOSPITAL LOCATION MAPS



Altoona
El. 1206 ft.
Canoe Creek S.P.
Etna Furnace
Lincoln Caverns
Juniata Coll.
El. 643 ft.
Huntingdon
McVeytown
Longfellow
Lakemont
Frankstown
Canoe Creek
Genister
Smithfield
Ardenheim
Swigert Museum
Atkinsons Mills
Matawana
MIFFLIN
Williamsburg
Geeseytown
Reese
Cove Valley Airport
McConnellstown
Ryde
Hollidaysburg
Royer
Hesston
Mill Creek
Clappertown
Oreminea
Raystown Lake
Newton Hamilton
BLUE MTN.
SHADE MTN.
Leamersville
Beavertown
Marklesburg
Mapleton
Mount Union
Kistler
Tuscarora State Forest
McKee
BLAIR
HUNTINGDON
Allenport
Cross Keys
East Sharpsburg
Entriken
Calvin
Martinsburg
Trough Creek S.P.
Barneytown
BLACKLOG MTN.
Roaring Spring
Fredericksburg
Russellville
Blair Co. Arpt.
Cherrytown
Cassville
Shirleysburg
Blacklog
Tuscarora
Waterloo
Curryville
Shy Beaver
Blairs Mills
Henrietta
East Broad Top R.R. (Narrow Gauge)
Big Spring S.P.
Bakers Summit
Todd
Orbisonia
Concord
Woodbury
Saxton
Rockhill
TUSCARORA MTN.
Stonerstown
Coalmont
Broad Top City
Saltillo
Tuscarora S.F.
Waterside
Warriors Path S.P.
Dudley
Doylesburg
New Enterprise
Robertsdale
Three Springs
Shade Gap
Defiance
Coaldale
Wood
Neelyton
Dry Run
BLUE MTN. TUN.
Loysburg
Riddlesburg
New Grenada
Aughwick
Spring Run
KITTATINNY TUN.
Salemville
Hopewell
Kearney
Maddensville
TUSCARORA MTN.
Yellow Creek
Langdondale
Waterfall
Roxbury
Clear Ridge
Enid
Burnt Cabins
TUSCARORA TUNNEL
Willow Hill
Cypher
HARBOR MTN.
Wells Tannery
Gracey
Fort Littleton
Upper Strasburg
Tatesville
Raystown Br.
Juniata
Hustontown
Fannettsburg
Graceville
King Knob 2107 ft.
W. Branch
Pleasant Hall
Everett
Breezewood
Saluvia
Knobsville
Cowans Gap S.P.
Nyesville
Bedford
Bedford Village
Earlston
BUCHANAN S.F.
Harrisonville
Metal
FRANKLIN
Letterkenny Army Depot
Gapsville
FULTON
Richmond Furnace
Red Bridge
Wilson Coll.
Crystal Spring
Andover
TWO LANES
Edenville
Chambersburg
El. 621 ft.
Clearville
Emmaville
Sipes Mill
McConnellsburg
Meadow Grounds Lake
Fort Loudon
St. Thomas
Stoufferstown
Cito
Buchanan's Birthplace S.P.
Browns Mill School
New Franklin
TOWN HILL
Webster Mills
Markes
Cove Gap
Needmore
Big Cove Tannery
Lemasters
Williamson
Marion
Kauffman
Amaranth
Mercersburg
DICKEYS MTN.
Upton
Shimpstown
Zullinger
Buck Valley
Claylick
Greencastle
Shady Grove
Lashley
Whitetail Ski Resort
Welsh Run
Warfordsburg
Plum Run
Sylvan
Kasiesville
Worleytown
Kasies Knob 1750 ft.
State Line
Hancock
Hagerstown
W. VA.
Tonoloway
Licking
Big Cove

APPENDIX C

FORMS

U.S. ARMY ACCIDENT REPORT Instructions

General. The unit having the accident must investigate it and complete this report. Complete the shaded portions ***only*** for: Military off-duty, non-fatal accidents; and military on-duty accidents resulting in less than 20 lost workdays. Accidents involving 20 or more lost workdays and/or total property damage of $2,000 or more will require completion of the entire report. Type or legibly print the report. Items may be continued on a blank sheet of paper and attached to the report. Items listed below are keyed to the block numbers of DA Form 285, May 91. Items not listed here are self explanatory. Specific questions concerning this form should be referred to the local safety office.

SECTION A - Accident Information

Note: This section should be completed for the initial report and for any changes to a previously submitted report.

1. Check "INITIAL" if this is the first report on the accident. Check "CHANGE" if this report is a change to a previously submitted report of the accident.

2. Enter the 6-digit Unit Identification Code *(UIC)* for the unit responsible for the accident *(e.g., WXXXXX)*.

3. Provide military unit information for the unit listed in Block *2*.

a. Full military address *(e.g., C Troop, 1/17 Cavalry, Ft. Bragg, NC 12345-6789)*.

b. Provide the unit branch *(e.g., Armor, Infantry, Transportation)*.

4. Enter the year, month, and day of the accident *(e.g., 90 11 07 {7 November 1990})*.

5. Enter the military time the accident occurred *(e.g., 0815, 2300)*.

7. Check either item *a* or *b*, depending on the location of the accident.

8. If item *a* is checked, state name of post or installation *(e.g., Ft. Bragg, NC; Federal Center, Atlanta, GA; Ft. Hood, TX; Shaw AFB, SC)*.

9. Check item *a* if accident occurred in a theater of hostile fire or enemy action, but not as a result of such fire/action. This includes direct preparation for combat, actual combat, or redeployment from a combat theater.

10. Check "Yes" of explosives *(C-4, TNT)*, ammunition, or pyrotechnics were involved and explain in Block *63* its involvement and specify the National Stock Number *(NSN)*.

11. Give enough detail to find the exact location of the accident *(e.g., building number, street or highway name, state and/or country)*. Also state the type of location *(e.g., road intersection, tank trail, family housing, firing range)*.

SECTION B - Personnel Information

Note: Complete this section for each individual involved and/or injured in the accident. "Involved"means any person who was injured, or who took actions, or made decisions which caused or contributed to the accident. If more than one person was involved, enter information on one person on the initial form and complete only Sections A and B on additional forms for others. Staple all forms together.

16. Enter individual's rank/grade *(e.g., E5/SGT, O3/CPT, GS-11, WG-8)*. Complete for all Government personnel.

17. Enter individual's full MOS/Job Series *(e.g., 54E20, 11B40, GS-301)*.

18. Provide individual's full ***Military*** address for all Government personnel. If this address is not the same as that in Block *3a*, provide the unit UIC.

21. State how many continuous hours without sleep this individual was on-duty prior to the accident.

22. Indicate how many hours of continuous sleep this individual had in the past 24 hours.

23. State the estimated number of days this individual will be away from work *(totally unable to perform any work, bed rest/on quarters)*. Does not include days hospitalized.

24. State the estimated *(or actual)* number of days this individual is hospitalized *(inpatient/admitted)* receiving treatment. Days hospitalized for "observation only" are not reported.

25. State the estimated number of days this individual will not be able to perform his or her regular duties *(light duty, profile)*.

26. Check appropriate block. If more than one applies, check the most severe.

28. For this individual's "most severe injury", check the appropriate block(s) *(no more than 3)* that indicate the cause of the injury.

29. **Number** the body part(s) most seriously injured *(no more than 3)* in their order of priority *(the most serious first)*. Be as specific as possible.

30. For each body part numbered in block *29*, place a corresponding number to indicate the type of injury received *(select only the most serious)*.

31. Check the appropriate block that best describes the individual's action at the time of the accident. If Block *31gg* is checked, complete Blocks *76* and *77* of Section H, as indicated by these instructions.

32. Provide a short but detailed explanation of the item checked in Block *31*.

Note: For this report, the following definitions apply:

Tactical Training - Training in a field environment that uses or develops combat or combat support skills.

Field Exercise and Tactical Training - This begins when the individual reports to his or her primary duty location for movement to the field site and ends when he or she arrives back at the primary duty location from the field.

33. Check "Yes" if activity listed in Block *31* was part of a field exercise. State name of exercise if it has a name *(e.g., Team Spirit, Reforger)*.

42. If vision enhancement device(s) were used, specify type and model numbers, and whether they caused the accident *(e.g., Night Vision Goggle, AN-PVS5A)*

43. Provide standard or reference *(Soldier's Manual, AR, TM, etc.)*, if it exists, that covers performance of the activity identified in Block *31*.

46. Provide a simple explanation of the mistake(s) or how the activity or task was performed incorrectly *(e.g., SGT Smith improperly backed his M915 truck without a ground guide)*.

47. **In your opinion**, why was the mistake made or the activity performed incorrectly? Check the most important reason.

51. Check the block corresponding to the piece of equipment associated with the person in Block *12 (e.g., SGT Adams was driving the "at-fault" HMMWV; his name will be in Block 12, and his vehicle will be Item a in Section C below)*.

SECTION C - Property/Material Involved

Complete Blocks *52-59* on each piece of property or item of equipment involved in the accident *(whether damaged or not)*. Include Army and non-Army, as well as equipment whose use or misuse contributed to the accident. Include up to 3 items of equipment on the initial form. Use additional blank sheets of paper for other equipment if necessary, continuing letter sequence *(e.g., A, B, C, D, and E)*.

52. Type of equipment *(e.g., sedan, truck, generator)*.

53. Full military equipment model number or civilian make *(e.g., M109A2, M60A2, Ford Taurus, M16 Rifle)*.

55. Estimated cost of damage *(ECOD)* or actual cost of damage *(ACOD)* for each piece of property, which includes costs of parts and labor.

57. Indicate if this specific item was being towed ***at the time of the accident.***

58. If Block *57* is "yes", indicate which item was doing the towing.

60. Complete for each component or part whose failure or malfunction contributed to the accident. Include the EIR/QDR number in Block *60e*.

61. Indicate how and why each component or part failed or malfunctioned by selecting from the lists provided and entering the appropriate number in the blocks provided.

SECTION D - Environmental Conditions Involved

62. Check the environmental conditions present at the time of the accident *(no more than 3)* by checking appropriate blocks, whether contributing to the accident or not. Also check whether they caused or contributed to the accident.

SECTION E - Accident Description/Narrative

63. Fully describe the sequence of events that lead up to and caused the accident. Explain how and why the accident occurred. Also include information required from Blocks *10* and *47*.

SECTION F - Corrective Action and Command Review

Note: The level of command review *(Company, Battalion, Division, etc.)* is determined by either the major Army command *(MACOM)* or installation policy.

65. Fully describe all actions taken, planned, or recommended to eliminate the cause(s) of this accident. Actions should be identified as appropriate at unit level, and all the way up to HQDA level.

SECTION G - SAFETY OFFICE USE ONLY

71. MACOM responsible for this accident *(FORSCOM, TRADOC, etc.)*.

SECTION H - Special Interest/Supplemental Information

This section is for use by the U.S. Army Safety Center, MACOMs, or interested safety offices to obtain additional "Special Interest/Supplemental Information" on this accident as needed *(e.g., M1 tank fires, tactical parachute accidents, etc.)*. Blocks *76* and *77* have been designated for collection of supplemental information on parachuting accidents.

Blocks *76* and *77*. If Block *31gg* was checked, provide the following supplemental information for each individual:

a. Name of jumper;
b. Jumper height;
c. Jumper weight;
d. Type of jump *(static line, non-tactical; static line, mass technical; freefall, non-tactical; freefall, tactical)*;
e. Type of parachute and model;
f. Jumper's equipment *(list)*;
g. Weight of equipment;
h. Wind direction and speed at
(1) Jump height,
(2) Drop zone;
i. Jump altitude;
j. Jumper's position in stick and door exited;
k. Time pre-jump conducted;
l. Date of last jump and type of jump;
m. Number of previous jumps;
n. Date graduated from basic airborne training *(year and month)*;
o. Type of aircraft;
p. Accident cause(s): Improper exit, static line injury, broken static line, parachute malfunction, entanglement, lost or stolen air, oscillation, unstable position, dragged on DZ, tree landing, drop zone hazard *(specify)*, or other.

U.S. ARMY ACCIDENT REPORT

For use of this form, see AR 385-40; the proponent agency is OCSA

FOR USASC USE ONLY

Requirement Control Symbol CSUCS-308

SECTION A - ACCIDENT INFORMATION

1. CHECK ONE	2. UIC (Unit Identification Code) (6-Digit Code of Unit Having Accident)	3a. UNIT NAME AND MILITARY ADDRESS	3b. BRANCH (Armor, Infantry, etc.)
☐ a. INITIAL ☐ b. CHANGE			

4. DATE OF ACCIDENT			5. TIME OF ACCIDENT (Local Military Time)	6. PERIOD OF DAY (Check one)	7. ACCIDENT OCCURRED (Check one)	8. IF ON POST, NAME OF INSTALLATION/FACILITY	9. ACCIDENT OCCURRED DURING (Check one)
a. YR	b. MO.	c. DAY		☐ a. Day ☐ b. Night	☐ a. On Post ☐ b. Off Post		☐ a. Combat ☐ b. Non-Combat

10. WERE EXPLOSIVES OR AMMUNITION INVOLVED OR PRESENT?	11. EXACT LOCATION OF ACCIDENT (Detailed enough to locate site) (State type of location.)
☐ Yes (See Instruction Book) ☐ No	

SECTION B - PERSONNEL INFORMATION

12. NAME (Last, First, MI)		
13. SOCIAL SECURITY NUMBER (SSN)	14. AGE	
15. SEX (Check) ☐ a. Male ☐ b. Female	16. RANK OR GRADE	17. MOS OR JOB SERIES

18. ADDRESS (Use Official Address for All Military or Government Personnel) (If different than block 3, add UIC.)

19. DUTY STATUS AT TIME OF ACCIDENT (Check one)	20. FLIGHT STATUS (Check one)
☐ a. On Duty ☐ b. Off Duty	☐ a. Yes ☐ b. No

21. CONTINUOUS DUTY (hrs.) (Without sleep)	22. HRS. SLEEP IN LAST 24

23. DAYS LOST (Est. no. of days lost from work; not counting day of injury. Bed rest on quarters.)	24. DAYS HOSPITALIZED (Est. no. of days hospitalized receiving treatment; not for observation only.)

25. DAYS OF RESTRICTED WORK ACTIVITY (Est. number of days person cannot perform regular duties; light duty/profile.)

26. SEVERITY OF ILLNESS/INJURY (Check One)

- ☐ a. **Fatal.**
- ☐ b. **Permanent Total Disability.** Person can never again do gainful work
- ☐ c. **Permanent Partial Disability.** Person loses or can never again use a body part
- ☐ d. **Days Away from Work.** Person misses one or more workdays; bed rest/on quarters.
- ☐ e. **Restricted Work Activity.** Person is temporarily unable to perform regular duties; light duty/profile
- ☐ f. **First Aid Only.** Person has one-time treatment of minor injury. (No lost work days.)
- ☐ g. **No Injury.**

27. CLASSIFICATION AT TIME OF ACCIDENT (Check)

- ☐ a. Active Army
- ☐ b. Army Civilian
- ☐ c. Army Contractor
- ☐ d. Nonappropriated Fund (NAF)
- ☐ e. Other U.S. Military
- ☐ f. ROTC
- ☐ g. Dependent
- ☐ h. NGB Tech
- ☐ i. NGB IDT
- ☐ j. NGB AT
- ☐ k. NGB ADSW
- ☐ l. NGB AGR
- ☐ m. NGB ADT
- ☐ n. USAR IDT
- ☐ o. USAR AT
- ☐ p. USAR ADT
- ☐ q. USAR FTM
- ☐ r. Foreign Nat. Direct Hire
- ☐ s. Foreign Nat. Indirect Hire
- ☐ t. Foreign Nat. KATUSA
- ☐ u. Foreign Mil. Attached to the U.S. ARMY
- ☐ v. Public
- ☐ w. Not reported

28. CAUSE OF INJURY/OCCUPATIONAL ILLNESS (Check the most serious)

- ☐ a. Struck Against
- ☐ b. Struck By
- ☐ c. Fell from Elevation
- ☐ d. Fell from Same Level
- ☐ e. Caught In/ Under/ Between
- ☐ f. Rubbed/abraded
- ☐ g. Bodily Reaction
- ☐ h. Overexertion
- ☐ i. Exposure
- ☐ j. External Contact
- ☐ k. Ingested
- ☐ l. Inhaled

29. BODY PART(S) AFFECTED (Check primary) (No more than 3)

- ☐ a. Body (General)
- ☐ b. Head
- ☐ c. Forehead
- ☐ d. Eyes
- ☐ e. Nose
- ☐ f. Jaw
- ☐ g. Neck
- ☐ h. Trunk
- ☐ i. Chest
- ☐ j. Heart
- ☐ k. Back
- ☐ l. Shoulder
- ☐ m. Arm
- ☐ n. Wrist
- ☐ o. Hand
- ☐ p. Fingers
- ☐ q. Leg
- ☐ r. Knee
- ☐ s. Ankle
- ☐ t. Foot
- ☐ u. Toes
- ☐ v. OTHER (Specify)

30. TYPE OF INJURY/ILLNESS (Check the most serious)

- ☐ a. Burns (Chemical)
- ☐ b. Burns (Thermal)
- ☐ c. Amputation
- ☐ d. Decompression Sickness
- ☐ e. Asphyxiation (Suffocation)
- ☐ f. Fractures
- ☐ g. Dislocation
- ☐ h. Abrasions
- ☐ i. Concussion
- ☐ j. Sprain/Strain
- ☐ k. Cuts/Lacerations
- ☐ l. Contusion
- ☐ m. Puncture Wound
- ☐ n. Hernia, Rupture
- ☐ o. Frostbite
- ☐ p. Heat Stroke
- ☐ q. Heat Exhaustion
- ☐ r. Noise Injury/Illness

SECTION B - PERSONNEL INFORMATION *(Continued)*

31. Person's action(s) at time of accident ***(Check one and explain in Block 32.)***

a. Soldiering	j. Test/Study/Experiments	s. Fabricating	aa. Hobbies
b. Combat Soldiering	k. Educational	t. Handling Material/Passengers	bb. Passenger
c. Physical Training	l. Information and Arts	u. Janitorial/ Housekeeping/ Grounds Keeping	cc. Human movement
d. Weapons Firing	m. Food and Drug Inspection		dd. Horseplay
e. Engineering or Construction	n. Laundry/Dry Cleaning Services	v. Food/Drink Preparations	ee. Bystanding/spectating
f. Communications	o. Pest/Plant Control	w. Supervisory	ff. Personal Hygiene/Food/Drink Consumption/Sleeping
g. Security/Law Enforcement	p. Operating Vehicle or Vessel	x. Office	
h. Fire Fighting	q. Handling Animal	y. Counseling/Advisory	gg. Parachuting *(See Instructions)*
i. Patient Care *(People/Animals)*	r. Maintenance/Repair/Servicing	z. Sports	

32. SPECIFIC DESCRIPTION OF ACTIVITY/TASK

33. ON FIELD EXERCISE *(Check one)*

☐ a. Yes (If YES, specify name of exercise.)

☐ b. No

34. ACTIVITY PART OF TACTICAL TRAINING? *(Check one)*

☐ a. Yes

☐ b. No

35. Type of training facility being used ***(Check one)***

a. Garrison	d. NTC	g. Std. range facility/ live fire
b. Local training area	e. JRTC	h. Other *(Specify)*
c. Major training area	f. CMTC	

36. Type of training participating in at the time of accident ***(Check/specify)***

a. School *(Specify)*			
b. Unit →	(1) Platoon	(2) Crew	(3) Individual
c. On-the-job training	d. Other *(Specify)*		

37. Last time individual received training prior to accident on activity specified in block 31? ***(Check one)***

a. 0 - 3 months	e. 1 - 2 years
b. 3 - 6 months	f. More than 2 years
c. 6 - 9 months	g. Never
d. 9 - 12 months	h. Not applicable

38. Required protective equipment

CHECK APPROPRIATE BLOCK(S)	AVAILABLE? YES	AVAILABLE? NO	USED? YES	USED? NO	N/A
a. Seat belt					
b. Helmet					
c Goggles/glasses					
d. Gloves					
e Ear plugs					
f Other *(Specify)*					

39. INDIVIDUAL LICENSED TO OPERATE VEHICLE/EQUIPMENT? *(Check one)*

☐ a. Yes ☐ b. No ☐ c. N/A

40. DID ALCOHOL CAUSE/CONTRIBUTE TO THIS ACCIDENT? *(Check one)*

☐ a. Yes ☐ b. No ☐ c. Unknown

41. If drugs caused/ contributed to this accident, check appropriate block.

a. Prescription	
b. Illegal	
c. Over-the-counter	
d. None	

42. Were vision enhancement devices being used? ***(Check appropriate block.)***

a. Yes *(Specify type/model in c and d.)*		
b. No		
	c. TYPE	d. MODEL

43. Standard/Reference covering activity/task

a. Soldier's Manual *(Task No.)*	
b CTT *(Task No.)*	
c. AR/TM/FM *(Specify)*	
d. SOP	e. None *(Go to block 45.)*

44. WAS ACTIVITY/TASK PERFORMED IAW STANDARD/REFERENCE? *(Check one)*

☐ a. Yes ☐ b. No *(If NO, complete blocks 46-47.)*

45. DID INDIVIDUAL MAKE A MISTAKE? *(Check one)*

☐ a. Yes *(If YES, complete blocks 46-47.)* ☐ b. No

46. What was the mistake? How was the activity/task performed incorrectly? ***(Explain below.)***

47. Why was mistake made/activity performed incorrectly? ***(Check the most important reason and specify in Block 63.)***

a. Inadequate school training *(content/amount)*	f. In a hurry	k. Inadequate services
b. Inadequate unit training *(content/amount)*	g. Poor/bad attitude	l. Improper equipment design
c. Inadequate on-the-job training *(content/amount)*	h Lack of rest/sleep	m. Inadequate written procedures *(AR, TM, SOP)*
d. Fear/ excitement	i. Effects of alcohol/drugs	n. Improper supervision
e. Overconfident in own/others abilities	j. Inadequate facilities	o. Other *(Specify in narrative)*

SECTION B - PERSONNEL INFORMATION *(Continued)*

48. Time licensed on this vehicle *(Check one)*	49. Total AMV driving mileage *(Check one)*	50. Total time in unit *(Check one)*
☐ a. Less than one year	☐ a. Less than 1,000 miles	☐ a. Less than 6 months
☐ b. One to two years	☐ b. 1,000 - 5,000 miles	☐ b. 6 months - 1 year
☐ c. Over two years	☐ c. 5,000 - 10,000 miles	☐ c. Over one year
☐ d. Unlicensed	☐ d. Over 10,000 miles	

51. WHICH ITEM FROM SECTION C APPLIES TO THE INDIVIDUAL NAMED IN BLOCK 12? *(This is needed in order to relate the person in block 12 to the equipment/vehicle below.)*

☐ Item A ☐ Item B ☐ Item C ☐ OTHER *(Specify)*

SECTION C - PROPERTY/MATERIAL INVOLVED *(Whether Damaged or Not)*

	ITEM A	ITEM B	ITEM C
52 Type of item			
53 Model number			
54 Ownership *(DOD, DA, POV, Unit, Person)*			
55 Dollar cost of damage			
56 Rollover protection system installed?	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA
57 Was this item being towed?	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA
58 If towed, enter letter for item doing towing			
59 Types of collision codes *(Pick up to three from list below and enter in blocks.) (In sequence.)*			

Types of Collisions

1 - Going forward and collided with moving vehicle
2 - Going forward and collided with parked vehicle
3 - Collision while backing
4 - Collision with pedestrian
5 - Collision with object (other than vehicle/pedestrian
6 - Overturned
7 - Ran off the road
8 - Jackknifed
9 - Going forward and rear-ended moving vehicle
10 - Going forward and rear-ended parked vehicle
11 - Collision while turning
12 - Other *(Specify)*

60. Component/Part that Failed/Malfunctioned *(Complete this section if a materiel failure/malfunction caused/contributed to the accident.)*

	ITEM A	ITEM B	ITEM C
a. National Stock Number			
b. Part Number			
c. Describe Part			
d. Manufacturer's Identification Code			
e. EIR/QDR Number			

61 How/Why Part Malfunctioned *(Select code from "How" list below and enter in first block; select code from "Why" list and enter in second block.)*	ITEM A HOW	ITEM A WHY	ITEM B HOW	ITEM B WHY	ITEM C HOW	ITEM C WHY

***How Part Failed/Malfunctioned* Codes**

1 - Overheated/burned/melted
2 - Froze *(temperature)*
3 - Obstructed/pinched/clogged
4 - Vibrated
5 - Rubbed/worn/frayed
6 - Corroded/rusted/pitted
7 - Overpressured/burst
8 - Pulled/stretched
9 - Twisted/torqued
10 - Compressed/hit/punctured
11 - Bent/warped
12 - Sheared/cut
13 - Decayed/decomposed
14 - Electric current action
15 - Unknown/Other
Blank - Not reported

***Why Part Failed/Malfunctioned* Codes**

1 - Improper equipment design
2 - Inadequate maintenance
3 - Inadequate manufacture of equipment
4 - Inadequate written procedures *(AR, TM, SOP)*
5 - Improper supervision
6 - Unknown
7 - Other *(Specify in narrative)*

SECTION D - ENVIRONMENTAL CONDITIONS INVOLVED

62. **Environmental conditions.** *(Check environmental conditions present and indicate if condition caused/contributed to the accident.)*

PRESENT	CAUSED/ CONTRIBUTED	CONDITION	PRESENT	CAUSED/ CONTRIBUTED	CONDITION
		a Clear/dry, visibility unlimited			k Wind gust/turbulence
		b Bright, glare			l Vibrate, shimmy, sway, shake
		c Dark, dim			m Radiation, laser, sunlight
		d Fog, condensation, frost			n Holes, rocky rough, rutted, uneven
		e Mist, rain, sleet, hail			o Inclined/steep
		f Snow, ice			p Slippery *(not due to precipitation)*
		g Dust, fumes, gasses, smoke, vapors			q Air pressure *(bends, decompression, altitude, hypoxia)*
		h Noise, bang, static			r Lightning, static electricity, ground
		i Temperature/humidity *(cold, heat)*			s. OTHER *(Specify)*
		j Storm, hurricane, tornado			

SECTION E - ACCIDENT DESCRIPTION/NARRATIVE *(From blocks 10, 47)*

63. GIVE THE SEQUENCE OF EVENTS THAT AMPLIFY/EXPLAIN WHAT HAPPENED, LEADING UP TO AND INCLUDING THE ACCIDENT. *(Explain why accident happened.)*

64a. PRINTED/TYPED NAME OF PERSON COMPLETING THIS REPORT	64b. RANK	64c. TITLE	
64d. SIGNATURE		64e. DATE OF SIGNATURE *(YY/MM/DD)*	64f. TELEPHONE NO.

SECTION F - CORRECTIVE ACTION AND COMMAND REVIEW

65. DESCRIBE THE ACTIONS TAKEN, PLANNED, OR RECOMMENDED TO ELIMINATE THE CAUSE(S) OF THIS ACCIDENT *(from unit level up to HQDA)*.

66a. PRINTED/TYPED NAME OF COMMANDER	66b. RANK

66c. SIGNATURE	66d. DATE OF SIGNATURE *(YY/MM/DD)*	66e. TELEPHONE NO.

	a. TYPED NAME	b. SIGNATURE	c. TITLE	d. RANK / DATE
67				
68				
69				

SECTION G - *SAFETY OFFICE USE ONLY*

70. LOCAL REPORT NO	71. MACOM

72. **Accident type** *(Check choice)*

	a. Army Motor Vehicle		h. Other Army Vehicle		o. Personal Injury - Other
	b. Army Combat Vehicle		i. Fire		p. Property Damage - Other
	c. Army Operated Vehicle		j. Chemical Agent		q. POV - On Official Business
	d. POV - Not on Official Business		k. Explosive		r. Space
	e. Marine Diving		l. Missile		s. Commercial Carrier/Transportation
	f. Marine Underway		m. Radiation		
	g. Marine Not Underway		n. Nuclear		

73. NAME OF SAFETY POINT OF CONTACT *(POC)*	74. PHONE NO. OF SAFETY OFFICE POC *(AUTOVON, Commercial, Etc.)*	75. DATE REPORT COMPLETED BY SAFETY OFFICE *(YY/MM/DD)*

SECTION H - SPECIAL INTEREST AND/OR SUPPLEMENTAL INFORMATION

76.	
77.	
78.	
79.	

IT ACCIDENT REPORTING/INVESTIGATION FORMS

INTERNATIONAL TECHNOLOGY CORPORATION

SUPERVISOR'S EMPLOYEE INJURY REPORT

This is an official document to be initiated by the employee's supervisor. Please answer all questions completely. This report must be forwarded to the employee's Regional Health and Safety office within 24 hours of the injury.

Injured's Name_____ Sex____ S.S. No._____ Birthdate_____

Home Address_____ City_____ State_____ Zip_____ Phone_____

Job title_____ Employee P.C._____ Hire Date_____ Hourly wage_____

SUPERVISOR

Date of incident_____ Time_____ Time reported_____ To whom?_____

Client name_____ Client address_____ Time shift began_____

Exact location of the incident_____ Did the employee leave work? ☐ No ☐ Yes When_____

Has employee returned to work? ☐ No ☐ Yes When_____ Did employee miss a regularly scheduled shift? ☐ No ☐ Yes

Doctor/Hospital name_____ Address_____

Witness name(s)_____ Statement attached? ☐ No ☐ Yes

Nature of injury_____ Exact body part_____

Medical attention: ☐ None ☐ First aid on site ☐ Doctor's office ☐ Hospital ER ☐ Hospitalized

Job assignment at time of incident_____ Job:_____ Phase:_____ Task:_____ Subtask:_____

Describe incident_____

What unsafe physical condition or unsafe act caused the incident?_____

What corrective action has been taken to prevent recurrence?_____

Supervisor/Foreman _____ (Print) _____ Signature _____ Date

MANAGER

Comments on incident and corrective action_____

Manager's name _____ (Print) _____ Signature _____ Date

HEALTH AND SAFETY

Concur with action taken? ☐ No ☐ Yes Remarks_____

OSHA Classification:

☐ Incident only ☐ First aid ☐ Recordable, no lost work days ☐ Lost work days ☐ Restricted activity ☐ Fatality

Days away from work_____ Days restricted work_____ Total days charged_____

☐ State jurisdiction ☐ Federal L & H ☐ Date ER submitted _____ Which claims office_____

Coding: A. Injury type or illness____ B. Injured body parts____ C. Activity at time of accident____ D. Injury cause code__

E. Agent code____ F. Safety rule violated code____ G. Accident prevention code__

Name _____ (Print) _____ Signature _____ Date

Form HS020A 8/25/84

Submit copies to: Corporate HS, Corporate Risk Mgmt., Region HS, Profit/Cost Center Mgr. and EMR

INTERNATIONAL TECHNOLOGY CORPORATION

VEHICLE ACCIDENT REPORT

IT Vehicle

DRIVER_____ ACCIDENT DATE_____ DRIVERS LICENSE_____ STATE_____

ADDRESS_____

CITY_____ STATE_____ STATE_____ ZIP_____

WORK PHONE #(____)_____ SS#_____ PC#_____

VEHICLE #_____ YEAR_____ MAKE_____ MODEL_____ LICENSE PLATE #_____

STATE_____ VEHICLE OWNER: ☐ IT CORP. ☐ LEASED/RENTED ☐ PRIVATE VEHICLE

VEHICLE TYPE: ☐ COMMERCIAL MOTOR VEHICLE ☐ NON-COMMERCIAL

IF NOT OWNED: OWNER_____ PHONE (____)_____

ADDRESS_____ STATE_____ ZIP_____

VEHICLE DAMAGE_____

OF VEHICLES TOWED FROM SCENE_____ NUMBER OF INJURIES_____ NUMBER OF FATALITIES_____

WERE HAZARDOUS MATERIALS RELEASED? ☐ YES ☐ NO IF YES, DESCRIBE MATERIALS_____

Other Vehicle(s)

DRIVER_____ DRIVERS LICENSE_____ STATE_____

ADDRESS_____

CITY_____ STATE_____ STATE_____ ZIP_____

PHONE #(____)_____ SS#_____

OWNERS NAME (CHECK IF SAME AS DRIVER ☐)_____

ADDRESS_____

CITY_____ STATE_____ ZIP_____

INSURANCE COMPANY_____ POLICY #_____

AGENT'S NAME_____ PHONE # (____)_____

ADDRESS_____

CITY_____ STATE_____ ZIP_____

VEHICLE: YEAR_____ MAKE_____ MODEL_____ PLATE #_____ STATE_____

VEHICLE DAMAGE_____

PASSENGERS: ☐ YES (List on reverse) ☐ NO INJURIES: ☐ YES (List names & addresses on reverse) ☐ NO

Accident Description

DATE_____ TIME_____ A.M. or P.M.

LOCATION (CITY,STATE)_____

DESCRIPTION OF ACCIDENT_____

WITNESS_____ PHONE # (____)_____

ADDRESS_____

POLICE OFFICER'S NAME_____ DEPARTMENT_____

EMPLOYEE_____ _____ DATE_____
(PRINT) (SIGNATURE)

SUPERVISOR_____ _____ DATE_____
(PRINT) (SIGNATURE)

PHONE OR FAX TO CORPORATE HEALTH & SAFETY AND JOHN McCARTHY WITHIN 24 HOURS, OR NOT LATER THAN NEXT BUSINESS DAY.
IT PHONE: (310) 378-9933 * IT FAX: (310) 791-2587**

INTERNATIONAL TECHNOLOGY CORPORATION

GENERAL LIABILITY, PROPERTY DAMAGE, & LOSS REPORT

DIVISION/SUBSIDIARY _____ CENTER NO. _____ DATE _____

ADDRESS _____

HOW DID DAMAGE OR LOSS OCCUR: _____

_____

_____

DESCRIPTION & VALUE ($) OF DAMAGED/LOST/STOLEN PROPERTY: _____

_____

_____

LOCATION OF DAMAGED/LOST/STOLEN PROPERTY (Before Loss): _____

_____

DATE & TIME OF DAMAGE, LOSS OR THEFT: Date: _____ Time: _____ a.m. / p.m.

OWNER OR DAMAGED/LOST/STOLEN PROPERTY:

Name _____ Phone No. ( ) _____

Address _____ City _____

Employer & Address _____

INJURED PARTIES (Also complete a Supervisors Employee Injury Report if an IT Employee):

1. Name _____ Phone No. ( ) _____

Address _____ City _____

Employer & Address _____

2. Name _____ Phone No. ( ) _____

Address _____ City _____

Employer & Address _____

WITNESSES:

1. Name _____ Phone No. ( ) _____

Address _____ City _____

Employer & Address _____

2. Name _____ Phone No. ( ) _____

Address _____ City _____

Employer & Address _____

WERE PICTURES TAKEN? ☐ YES ☐ NO

WERE POLICE NOTIFIED? ☐ YES ☐ NO DEPT. _____ REPORT NO. _____

COMPLETED BY: _____ _____ _____

(Print name) (Signature) (Date)

MANAGER _____ _____ _____

(Print name) (Signature) (Date)

Form HS020C 5/25/94

USE BACK SIDE IF NECESSARY

INTERNATIONAL TECHNOLOGY CORPORATION

ACCIDENT/INJURY INVESTIGATION

*** MUST BE COMPLETED WITHIN 72 HOURS ***

Date _____ Profit/Cost Center _____ Date of Accident/Injury _____

Employee Name _____

Supervisor Name _____

Job Number/Name _____ / _____

Location of Accident/Injury _____

- Accident/Injury Classification

Injury	Vehicle	DOT
☐ Near Miss	☐ Chargeable	☐ DOT Vehicle
☐ First Aid	☐ Non-Chargeable	☐ DOT Reportable
☐ OSHA Recordable	☐ Not at Fault	
☐ Lost Workday		General Liability ☐

- Description (Provide facts, describe how incident occurred, provide diagram (on back) or photos)

_____

_____

- Analysis 1 (What unsafe acts or conditions contributed to the incident?)

_____

_____

- Analysis 2 (What systematic or management deficiencies contributed to incident?)

_____

_____

- Corrective Action(s) (List corrective action items, responsible person, scheduled completion date)

_____

_____

- Witnesses (Attach statements or indicate why unavailable)

_____

_____

Investigated By _____ _____ _____
Print Name Signature Date

Manager _____ _____ _____
Print Name Signature Date

Form HS020E 8/25/94

(Attach Additional pages if needed)

INTERNATIONAL TECHNOLOGY CORPORATION

ACCIDENT REVIEW BOARD REPORT

TE: _____ LOCATION: _____

BOARD MEMBERS: _____

_____

_____

ACCIDENT DATE: _____ TYPE: _____

INVESTIGATION COMPLETE? YES _____ NO _____

IST PREVIOUS ACCIDENTS, INJURIES, OR OCCUPATIONAL ILLNESSES INVOLVING THIS EMPLOYEE: _____

_____

_____

EMPLOYEE(S) _____ PRINT NAME _____ SIGNATURE

_____ PRINT NAME _____ SIGNATURE

SUPERVISOR(S) _____ PRINT NAME _____ SIGNATURE

SE OF ACCIDENT: _____

CTION BY BOARD*: _____

_____

_____

* ALL ACTIONS BY THE ACCIDENT REVIEW BOARD ARE SUBJECT TO FINAL REVIEW BY THE HUMAN RESOURCES AND LEGAL DEPARTMENTS.

ACCEPTED: _____ EMPLOYEE

ACCEPTED: _____ MANAGER

_____

PPROVED: _____ HS MANAGER

REJECTED FOR: _____

_____

_____

APPROVED: _____ REGIONAL GENERAL MANAGER

REJECTED FOR: _____

_____

_____

OVED: _____ DIVISION DIRECTOR

REJECTED FOR: _____

_____

Form HS020D 5/25/94

INTERNATIONAL TECHNOLOGY CORPORATION

SAFETY INSPECTION REPORT

Distribution:

PART I

AUDITED BY: _____ DATE: _____

CLIENT: _____ TIME FROM: _____ TO: _____

PROJECT NO. _____ LOCATION: _____

PROJECT MANAGER: _____ SUPERVISOR: _____

FOREMAN: _____ LEADMAN: _____

DESCRIBE JOB ACTIVITIES: _____

_____

_____

SAFETY EQUIPMENT IN PLACE: _____

_____

_____

PART II

ITEM NUMBER 1. SAFETY CONTACT EMPLOYEE (NAME) _____

a. SAFETY ISSUE: _____

_____

_____

b. RECOMMENDATION: _____

_____

_____

c. ASSIGNED TO: _____ FOLLOW UP DATE: _____

d. CORRECTION VERIFIED: _____ DATE: _____

PART III

HEALTH AND SAFETY REVIEW: _____

HEALTH AND SAFETY REVIEWER: _____ DATE: _____

INTERNATIONAL TECHNOLOGY CORPORATION

SAFETY INSPECTION REPORT CONTINUATION

ITEM NUMBER ___ SAFETY CONTACT EMPLOYEE (NAME) ____________________

a. SAFETY ISSUE: ____________________

____

____

b. RECOMMENDATION: ____________________

____

____

c. ASSIGNED TO: ______________ FOLLOW UP DATE: ______________

d. CORRECTION VERIFIED: ______________ DATE: ______________

ITEM NUMBER ___ SAFETY CONTACT EMPLOYEE (NAME) ____________________

a. SAFETY ISSUE: ____________________

____

____

b. RECOMMENDATION: ____________________

____

____

c. ASSIGNED TO: ______________ FOLLOW UP DATE: ______________

d. CORRECTION VERIFIED: ______________ DATE: ______________

ITEM NUMBER ___ SAFETY CONTACT EMPLOYEE (NAME) ____________________

a. SAFETY ISSUE: ____________________

____

____

b. RECOMMENDATION: ____________________

____

____

c. ASSIGNED TO: ______________ FOLLOW UP DATE: ______________

d. CORRECTION VERIFIED: ______________ DATE: ______________

61298

International Technology Corporation

AUTHORIZATION FOR TREATMENT OCCUPATIONAL INJURY/ILLNESS

Location | PC Number

IT Division | Project number

Date of Incident/Exam / / | O injury O illness | Site Code

Brief description of injury/illness

Associate Last Name | Associate First Name

Associate SS# - - | Job Title

Location/Site City | Location/Site State | Location/Site Zipcode

HS Professional Last Name | HS Professional First Name

HS Professional Phone Number ( ) -

TO THE TREATING PHYSICIAN:

In the case of occupational injury/illness, please examine the employee and render necessary conservative treatment directly related to the occupational injury/illness.

Light Duty Work:

It is the policy of IT Corporation to provide work assignments, whenever possible, for employees with physical activity restrictions resulting from an occupational injury/illness. If the employee will be subject to a restriction, please contact the IT Medical Director before releasing the employee, so that a light duty assignment may be arranged.

Medically Unable to Return to Work:

It is the policy of IT Corporation to assist employees unable to return to work, due to an injury/illness, in obtaining needed medical care and other benefits available to them. Medical findings are also used to help evaluate unsafe conditions that may have led to the incident. Please help us assist our employees by contacting our Medical Director with your findings as soon as possible, preferably before the employee leaves your office, but not later than the close of business on the day of initial treatment.

IT Medical Director: David L. Barnes, M.D. Office: (404) 455-0818 FAX: (404) 457-1429

Reports and Bills :

1. If first-aid only: Send reports to: _____

2. If medical treatment provided send reports to: EMR 4360 Chamblee Dunwoody Rd. Suite 202 Atlanta, GA 30341
   Note that the worker's compensation claims administrator is Constitution State Service Company (Travelers). Send bills and payment inquiries to their local office.

IT Authorization Signature _____

Date / / | Phone Number ( ) -

Doctor, please provide:

Medical Diagnosis _____

Treatment Provided _____

Recommended Work Limitation / Restriction _____

Return Visit Needed O Yes O No When _____ First Aid Only O Yes O No

First Name Printed | Last Name Printed | Signature _____

OMB Approval No. 44-R-1555

REQUEST FOR EXAMINATION AND/OR TREATMENT

U.S. DEPARTMENT OF LABOR
EMPLOYMENT STANDARDS ADMINISTRATION
OFFICE OF WORKERS' COMPENSATION PROGRAMS

PART A - AUTHORIZATION

INSTRUCTIONS TO EMPLOYER. This side of the form must be completed in full, and authorizes a physician of the *employee's choice* (* See item 2 below) to examine and/or treat an employee, covered by the Federal workers' compensation act marked in the box at right, for accidental injury, illness or disease arising out of and in the course of employment.

Mark either box A or B in item 7. The original and at least two copies of this form are to be given to the physician. The physician is to complete the medical report and his initial bill on the reverse, sending within ten days the original of the report to the Deputy Commissioner and copies to the insurance company or employer named in item 13. Subsequent and regular follow-up reports should be submitted by the physician on Form LS-204 and/or in narrative reports, or whenever requested.

1. THIS AUTHORIZATION IS FOR EXAMINATION AND/OR TREATMENT UNDER THE WORKERS' COMPENSATION ACT MARKED BELOW:

- A ☐ Longshoremen's and Harbor Workers' Compensation Act
- B ☐ Defense Base Act
- C ☐ Nonappropriated Fund Instrumentalities Act
- D ☐ Outer Continental Shelf Lands Act
- E ☐ District of Columbia Compensation Act

2. Name and address of physician or medical facility authorized to provide medical service

*(The term "physician" includes doctors of medicine (MD), surgeons, podiatrists, dentists, clinical psychologists, optometrists, osteopathic practitioners, and chiropractors. Payment for chiropractic services is limited to charges for physical examinations, related laboratory tests, x-rays to diagnose a subluxation of the spine, and treatment consisting of manipulation of the spine to correct a subluxation demonstrated by x-ray. See 20 CFR 702.404)

3. Employee's name (*Last, first, middle*)	4. Date of injury (*Month, day, year*)	5. Occupation

6. How accident or illness occurred

7. You are authorized to provide medical services to the employee as follows:

- A ☐ If you believe the condition is related to the injury, or the employee's occupation, furnish office and/or hospital treatment as necessary for the effects of this injury.
- B ☐ If you are in doubt as to whether the condition(s) found on examination is related to the injury, you are authorized to examine the employee, using indicated non-surgical diagnostic studies, and should promptly advise those listed in item 13 whether you believe the disability is due to the alleged injury. Pending further advice you may provide necessary conservative treatment.

YOU ARE REQUESTED TO SUBMIT A WRITTEN REPORT OF FIRST TREATMENT WITHIN 10 DAYS TO THE DEPUTY COMMISSIONER AT THE OFFICE NAMED IN ITEM 12 BELOW *(See back of this form for instructions as to medical report and the submission of your charges).*

8. Signature and title of authorizing official (*Sign all copies*)	9. Name and address of employer
10. Telephone (*Area code and local number*)	11. Date authorized (*Month, day, year*)
12. Send one copy of your report to: U.S. DEPARTMENT OF LABOR EMPLOYMENT STANDARDS ADMINISTRATION OFFICE OF WORKERS' COMPENSATION PROGRAMS	13. Name and address of insurance carrier or self-insured employer to whom bill and copy of report are to be sent

Form LS-1

INTERNATIONAL
TECHNOLOGY
CORPORATION

RETURN TO WORK AUTHORIZATION
FOLLOWING MEDICAL ABSENCE

_____
Date

To: _____

Division: _____

Location: _____

_____ has been absent from work due to a:

- ☐ work related illness or injury _____ (date of injury)
- ☐ non-industrial illness or injury
- ☐ other

and has provided a satisfactory medical release certificate for:

- ☐ return to work, without restriction
- ☐ return to work subject to the attached "Physical Activity Restriction"*

_____
Health and Safety Department

* For "Physical Activity Restriction":
1. Have employee read and sign restriction
2. Provide manager signature
3. Return form intact to the Health and Safety Department

FORM HS105B 12/93